

AVIATION WEEK

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November 4, 1957 75 Cents

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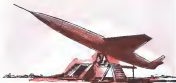
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AVIATION CALENDAR

(Continued from page 5)

Nov. 15-15th Annual Convention, 70th Annual Aeronautics and Astronautics Association, Hotel Adelphi, Dallas, Texas

Nov. 17-21-Rights National Fluids Exposition, International Airport, Chicago

Nov. 18-19-19th Nuclear Electric Management School, Instruments Division, Pacific Electronics Inc., 710 S. Fallon Ave., Los Angeles, N.Y.

Nov. 18-25-Science Camp for Amateurs in Research and Development, Constitution and Populism Fund, 12th meeting, Nov. 18-21-AGARD Aeromedical Panel, Sheraton Hotel, Washington, D.C.

Nov. 18-19-Turbine Conference, International Air Transport Association, Nov. 18-22-19th Meeting, Aviation Development and Manufacturing Association, Sheraton Culler Hotel, Detroit

Nov. 20-30-Annual Speeches Series, Civil Aeronautics Board, New York

Dec. 3-5-35th Annual Society, annual meeting, Hotel Statler, New York

Dec. 4-5-35th Annual Society, annual meeting, Hotel Statler, New York

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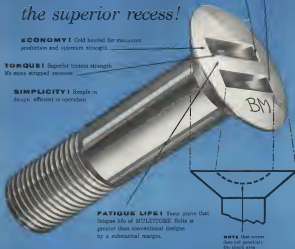
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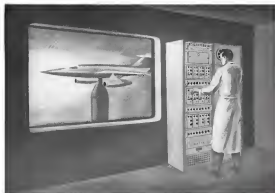
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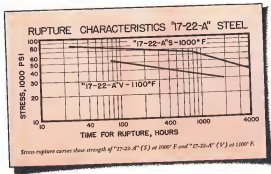
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100 amp. single pole, single throw Class B power relay with N.O. and N.C. auxiliary contacts.



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An aerial photograph of a large industrial facility, likely a tire manufacturing plant. The complex consists of several long, rectangular buildings with dark roofs. A parking lot filled with cars is visible in the upper right. A speech bubble containing the text "B.F. Goodrich" is positioned in the upper right area of the image.

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Who Are the Real Culprits?

It is high time the American people asked their government why, in view of the overwhelming evidence available to it during the past two years on Soviet technical progress, it is still pursuing a policy that is slowing the pace of our military technology and sapping our future military strength?

There has been plenty of reaction. On the one hand, the story and its accompanying editorial have stimulated daily newspaper stories and editorial reactions around the world. On page 79, we are reprinting editorial comment on this subject from leading American newspapers. We have also received similar reactions from aviation industry and cultural sources.

All of these machinations had a common or shared theme. For example, Mr. Hagerty fabricated at some length his daily newspaper reporter questioning him on the eve of his departure to back his comments with the aid of his own ex officio position. They appeared in the daily press *unnoticed*, attributed to a "New Administration official." Mr. Randall likewise made his comments at "unresolvable and unaided" privacy. Later that week, he made a public speech referring to the Soviet Sputnik satellite as a "Jolly little." This comment drew heart felt tears such a distinguished Republican leader as Sen. Steven Symington of New Hampshire.

But even more curious is the performance of Robert Celler on Saturday Oct. 26 at Hot Springs, Va. He was invited to speak before the Commerce Department's Business Advisory Council, which is a group of 100 leading businessmen who meet periodically to advise the government on national policy proposals. Saturday night is always a festive occasion of the council. The work, how-

been done, and council members and their wives have played a role in golf and tennis tournaments. At the Saturday night affair after dinner, the awards for these tournaments are made. The job of the speaker at that affair is primarily to get everyone in a happy mood and keep them there. The reception that precedes the dinner is always an enjoyable affair.

"There Robert Corfies, special assistant to President Eisenhower for national security affairs, virtually accuses a respected American trade journal's editors of treason and strongly implied the desirability of punishing the magazine for withholding advertising. His suggestion was made to members of the Council who represent the leadership of the nation's top business, industry and advertising budgets. It was made all the more at a closed session, so that there was presumably no way of countering it."

The New York Journal of Commerce reported as a further item on Mr. Galt's appearance before the Council:

By the middle of last week, Mr. Corley after sober reflection had a different version of the affair. Spurred through Whole Home Press Secretary Hagerty and doling direct contact with reporters, Mr. Corley denied he had mentioned "treason" or had suggested an advertising boycott. He admitted claiming that the *AMERICAN WORK* story was "slandering" and that the story was a violation of the law, although he would not state what law. He was also reported to be demanding that his Hot Springs associate had misled the newspaper "because no reporter was aware."

It is difficult to sift truth from fiction in the conflicting reports of Mr. Coffer's Hot Springs speech. We don't like to accept second hand reports because they are often inaccurate. But it is agreed by all parties concerned that Mr. Coffer said something like Wynn's publication of the article mentioned above was "abominable."

We would like to ask Mr. Coster and the American people which is the really shameful act:

- **Withholding the true story of the rapid program as Ravana wishes from the American people while at the same time cutting back our two military missions, weapons development and production programs to weaken our future military strength?**
- **On telling the American people the truth about the vital facts that were withheld from them as the phony grounds of "security" and pinning the proper label on the government officials who deliberately withheld this information?**
- Robert H. Bates

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Avco makes things better for America

Avco

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Washington Roundup

New Look at Soviets

Top scientific, industry and USAF technical brains met recently in Baltimore at a top secret meeting to take a fresh new look at the relative military aerospace strength of the U.S. and the Soviet Union. Meeting was chaired by President Eisenhower and presided over by Dr. Ed Teller, known best for his contribution in developing the hydrogen bomb. Meeting's consensus was that period of maximum U.S. danger from Soviets will begin as early as late 1958 in contrast to earlier estimates that 1960 would be start of the critical period. New estimates in Soviet air defense system against nuclear bombers such as B-47 and B-37 was major factor in the new estimates. Proposal for U.S. action to begin comparing the impact of industry have been submitted to President Eisenhower through the Defense Dept. staff.

No 'Ball-Park' Estimates

While for increased USAF efforts to force innovation into supplying more accurate estimates. Brig. Gen. W. Austin Davis, assistant for production programming in the office of the Deputy Chief of Staff, Material, puts it this way:

"Comparative functions must be assigned to give much more accurate forecasts regarding funds needed in a given month or quarter."

"These functions," Gen. Davis says, "must also be refined to show a true picture of dollar actually spent as to date on a given project. We must accept ball-park estimates."

It is no secret that USAF has been irritated by some of the off base figures offered recently. They were some estimated billings that were rising by millions of dollars, thus complicating the USAF choice of splitting a limited budget.

In another note, Gen. Davis has suggested that "industry should take the same dollar-conscious view toward developing systems for the Air Force that it takes toward private projects."

"According to reasonable estimates," the General says, "management development program that they do when using their private capital. If pushed to it, I could give specific examples."

"Now it rather there would be a slight and reasonable additional cost due to certain procedures for competition and security that 3% should cover this, not 40%."

Missile Decision Hanging Fire

Possibility of a fast decision from the three main committee studying relative merits of the Army Jupiter and USAF Thor intermediate range ballistic missiles appears remote in some Pentagon circles. Committee is composed of Maj. Gen. Bernard A. Schriever, commander of USAF's Ballistic Missile Division, Maj. Gen. John B. Medaris, chief of the Army Ballistic Missile Agency, and William H. Holladay, Special Assistant Secretary of Defense for Guided Missiles.

In effect, Holladay is sitting as a judge in the Army Air Force controversy without any higher competent authority to look over his shoulder. With a lack of top-level review on the subject, Holladay and staff are forced to rely on the principals for their technical information.

Possible solution for the impasse, Defense Secretary Neil H. McElroy may be forced to take over, seek advice from scientists, military experts and industry to find out which missile is best.

New Industry Probe

A House Small Business Subcommittee headed by Rep. Tom Studd (D-Calif.) is launching an investigation of the aircraft and guided missile industries to see if small firms are receiving a proper share of defense contracts.

ANDB Demise

An Aeronautical Development Board officially came to an end last week with a presidential order liquidating the agency's personnel, records, projects and funds amounting to \$7.2 millions in the newly organized Aeronautics Modernization Board. The President's action also suppresses the transfer of "current" research and development functions from the Defense and Commerce Departments to the new board, but does not effect the Civil Aeronautics Administration program for the testing, evaluation and modification of facilities and devices selected for use in the federal aircraft system under the CAA-awaken modernization plan.

'Awaken U. S.'

All scientists with whom President Eisenhower has talked in recent weeks "agree that this problem of awakening America is one in which they believe I have a part," the President said last week. Science Advisor, Committee for Office of Defense Mobilization, "in preparing a plan in which they hope to lay out my part of it," the President said, and he will follow the plan if he thinks it is feasible. "Because I believe exactly what they said."

Committee's chief concern is not relative position of scientific advancement of U.S. and our allies, nations but "where we are going to be in 10 years," Eisenhower said. The part will include "awakening the United States to the importance and need for the absolute accuracy of increasing our scientific output of our colleges and universities," even if "national" federal support is necessary.

Third Pilot vs. Engineer

Air Line Pilot Ann hopes of replacing flight engineers with a third pilot crew member as jet transports have been at least temporarily shorthanded at one airline. The American World Airways and Flight Engineers' International Union last week signed an agreement which called for a flight engineer as a crew member whenever more than two crew members are required by company in Civil Aeronautics Administration regulations.

As the 1955 limited contract expires, Air Line Pilot Ann introduced a resolution that would require 100 million of a flight crew to be qualified as pilots. However, the Pan American agreement, which was made June 1960, clearly spells out the airline's intention to retain flight engineers. The agreement says: "It is the specific intention of the parties that Pan American shall not engage a pilot-engineer, in the term as understood, in place of a professional engineer to perform the engineering function."

—Washington staff

Sputnik May Spur Overall Defense Probe

By Katherine Johnson

Washington-Soviet earth satellite probably will lead to congressional action to broaden the limits of probing the missile and missile programs. There were these developments:

• Sen. Lyndon Johnson (D-Tex.), Sen. majority leader and chairman of the Preparedness Subcommittee, expected to take the lead in conducting the whip and whiplash of the Soviet triangle, declared "it may be that our whole defense structure needs a thorough overhaul from top to bottom."

• Rep. George Mahon (D-Tex.), chairman of the House Appropriations Subcommittee on the Armed Services, expanded plans for a secret survey in the field of the missile program. The subcommittee will start its closed-door

sessions in Los Angeles with Maj. Gen. Ronald A. Schriever, commander of USAF's Air Research and Development Command, Robert Altrock, director, and William M. Harbo, special guided missile adviser to the Secretary of Defense.

• Sen. Edw. Kefauver (D-Tenn.), senior ranking member of the Preparedness Subcommittee called for a civilian cabinet-level secretary to oversee all scientific research and development. This is a recommendation that also has been made by Sen. Mike Mansfield (D-Mont.), Senate majority whip (AW Oct. 28, p. 29).

Sufficient Stimulus?

In line with the widespread congressional activity to oversee all Kefauver announced: "The Navy and

Air Force are trying for the top responsibility. Over time, the Secretary of Defense has been the supreme authority, but the program involves civil and military and has principal responsibility and he is not chosen for his knowledge of, or interest in, basic research.

"Furthermore, the program is not purely military in nature and both the Air Force and the Navy are principally interested in military development."

"Therefore, once at the first thing, we should do to get our program off the ground is place within the government a man of sufficient stature and position to command respect."

After West Coast conferences with guided missile communities, Mahon's subcommittee last week held closed-door sessions with Services of Defense Neil H. McEllen, and Deputy Defense Secretary Donald A. Douglas in Washington for Nov. 20 and 21.

The group will then proceed to the Redskins Arsenal.

Over the past year, Mahon has been in the forefront in the mounting congressional clamor for less competition and less dollar "waste" in the missile program (AW May 26, p. 30).

What Johnson Wants

Sen. Johnson reported the four questions he has directed the staff of his Preparedness Subcommittee to answer at the first public congressional hearings. They show the line the Senate majority will take:

- "Could we have initiated the Soviet rocket race?"
- "Would it have been worth while to match the Soviet achievement?"
- "Does the Soviet satellite indicate that this country has slipped behind in the development of its defense?"
- "If so, what do we have to do to catch up?"

The comments of Sen. Johnson—admirer of the general congressional treatment against increased defense expenditures—were:

"The more that the Soviet can put a satellite into the sky does not alter the world balance of power. But it does mean that there is a position to alter the balance of power. And they will do it if we remain where we are. The satellite may be a little more than a satellite toy. But a satellite that can produce such a toy can produce anything else that is conceivable. We must realize that the Soviet Union can produce any bomb, any rocket, any weapon that we can produce. It is only a question of time and cost that must be met and of a question of money."

"There is no point in spending more money unless we first know that the

money should spent has been used wisely. And there are certainly simple grounds for suggesting that some money even has been waste."

The missile program, Johnson continued, "have been the subject of constant bickering among the three services. It has meant inter-agency battles fought with all the force of the state—although not the bloodshed of our civil."

"It may be true that this country was in no race to produce the satellite. But certainly the armed services were engaged in a race with each other to control the guided missile. And we cannot afford more, more races like that."

"The independence that was accorded the three branches was not intended to be an invitation to waste money. And waste money is the one constant disease that seems to run through the missile program."

Without passing judgment on the charges and counter-charges among the services on missiles, Johnson concluded:

"It is clear that the people, looking at statistics needed introduction to each other."

"We will be able to solve the problems of the satellite and the missile only if current work is stopped with cooperation in the outdoors. And this represents the most important defense issue that will be before Congress in the months that is ahead. We will have to find ways and means of bringing some sense into our weapons development program. We cannot permit that glaring gap to continue."

Air Force May Split Production of WS-110

Washington—Air Force contract on WS-110A, the new missile competition between Boeing, Douglas, and North American Aviation Inc. may be divided between the two companies.

Air Force feels it shouldn't award the complete job to the winner on the theory that this would put the winner, state the loss.

Under this theory, the winner would have manufacturing responsibility for the complete system along with the bulk of the project, while the loser would get a good part of the detail design and production.

Another troublesome factor bothering high Air Force officials is the competition of the two WS-110A bidders that could be put into production, since the cost of providing for high flight temperatures, advanced equipment and the burden of new manufacturing techniques may make it more than twice that of Boeing's B-72.

Both North American and Boeing WS-110A designs involve a considerable amount of high-temperature work-



Another Thor Fired Successfully

Air Force Thor fires hoisting pad at Patrick AFB, Fla., in third successful firing. Firing of the Douglas intermediate range missile came and a flurry of missile headshots at the Florida test site (AW Oct. 28, p. 30).

construction—North American featuring stainless steel honeycomb panels. Boeing titanium alloy honeycomb.

Cost of the construction runs in

thousands. On Convair's B-58, there are 20 stainless steel honeycomb panels totaling 1,082 sq ft. Cost of this one structure, installed, runs between \$200 and \$400 per sq ft, depending upon the panel configuration, inserts, attach inserts etc. Quantities of stainless steel structure in WS-110 design undoubtedly is considerably greater than the B-58. Approximately 335 stainless steel honeycomb panels, including production tooling, for the B-58.

Results of this experience could be translated into the WS-110, but a considerable amount of untested development work would be required. Overcoming it, take care of the potential high-temperature growth factor is another one adding to costs of new designs such as that represented by the WS-110 category. Engineers close to the project say this temperature growth factor may never be achieved and should be minimized wherever possible by design conditions which may be expected only in a reasonable span of time.



Vanguard Launched at Cape Canaveral

Vanguard TV2 test vehicle is fired at Cape Canaveral, Fla., to test the General Electric third stage engine for the satellite program (AW Oct. 28, p. 25). Vehicle reached 109 mi altitude and speed of 4,290 mph during 140 sec. flight.



Kaman Unveils HU2K-1 Utility Helicopter

Kaman Aircraft Corp. exhibits a full-scale mockup of its first single-engine configuration, the HU2K-1, at the company's plant in Bloomfield, Conn. The helicopter design was selected by the Navy Bureau of Aeronautics in a competition for a utility helicopter (AM-100, 28 p. 22). The HU2K-1 will be powered by a General Electric T58 gas turbine engine by the Wright R-1500 request, was entered in nine entries by Bell and Hill.

Polaris Begins Underwater Tests

Washington—Falmouth, undersea tests of Navy's Polaris fast ballistic missile are being conducted to determine the influence of currents and other physical phenomena affecting launching conditions from submarines or ship launchers. For the Polaris, was recently tested (AM Oct. 28, p. 30) and Navy hopes to face a reasonably complete configuration within two years.

Polars will be about 47 ft. long. It will contain an Arrow-Comet solid propellant rocket 25 to 30 ft. long, intermediate between 34 and 45 ft. in diameter and weighing approximately

20,000 lb. Rocket burning time will be about 15 sec. Thrust will be about 100,000 lb.

For underwater launching, a nuclear-powered submarine undoubtedly would be used. Absence of fuel tanks found in conventional submarines would permit storage of at least a pair of the 47-ft. long missiles. Launching procedure involves, might involve a "torpedo pattern" launching, followed by a guided trajectory out of the water, or an angled trajectory directly from the coast.

Acceleration of the Polaris program at Lockheed Missile Systems Division

Simultaneously and Polaris, C&H, plans to scheduled to boost current capabilities from about 6,000 to 10,000 by end of 1958. In addition to Polaris, the division has about 15 other missile projects, some sponsored by military and others, research and development projects, by Lockheed.

French May License English Thunderbird

Paris—Production under license in France of the English Electric Thunderbird antiaircraft missile currently under study by the French Air Ministry, is being shown by the French to the British missile, together with confirmed reports of recent French request for information on American intermediate range strategic missiles, reflects growing French fear that their nation is falling behind in missile development.

Thunderbird is in production for the British Army and Royal Air Force. The rocket powered missile is boosted with a launching device by eight boosters in four pairs. Thunderbird missile presumably would replace the French gas turbine missile Fara on which the French reportedly have spent \$25 million.

If the French Air Ministry decides to place an order for the Thunderbird, the missile would be built in France by Sud Aviation. Talks between the French company and English Electric already are in progress and a special mission from Sud is slated to go to England later this month.



Peace is his profession

For more than a decade the officers and airmen of the United States Air Force Strategic Air Command have waged peace with all the vigor and resolution the military can give only to war. The survival of our civilization in which freedom of religion, education, art, science and government is threatened today upon the men who are practicing peace is a just cause profession. In this restless world these professional men are actively dedicated to our way of life!

REGISTERED AS A PUBLIC SERVICE BY CENSORSHIP A MEMBER OF NATIONAL STRATEGIC ORGANIZATION

Soviets Scorn Farnborough

Moscow—Russian observers were not greatly impressed by the aircraft and missiles displayed at England's Society of British Aircraft Constructors display in September (AM Oct. 9, p. 28), according to the Soviet U.S.S.R., Defense Ministry newspaper Izvestia. In a report on the show, the Soviet publication declared:

"Overall, the Farnborough exhibit demonstrated that British industry has the potential to manufacture modern types of aircraft equipment and, too, under certain conditions, to be a force for supplying this equipment to other capitalist countries. The show also indicated that the British aviation industry still lags in solving more technical problems and needs to establish serious contacts with other nations."

The "other nations" obviously refers to countries in the Soviet bloc. But this conclusion that a Russian delegation was not formally invited to Farnborough this year, although it had been in 1956. It said: "Several times during the exhibit during the last few days, our engineers were only allowed to attend when it was shown again to the general public. This situation demonstrates that the leaders of the British aviation industry are unwilling to improve the business contacts established last year through the exchange of various specialist delegations between the U.S.S.R. and Great Britain."



business case at New York, held between August after others from Miami where there had indeed on two papers following computer trouble encountered in both cities on one route (AWO, Fig. 7, p. 18). The British Overseas Airways Corp. 312 model of the Boeing transporter is scheduled for further proving flights before entering BOAC service. Its key components engines incorporate composite blade configurations. Final reports in London that present results so far as well as difficulties with previous engine has been presented recently, involve testing off its own engine's progress and finding it able to make good time. Evaluation of the aircraft's performance will be completed by the end of the year. Leading edge of fin and stabilizer are under order. Design team, now in operation electronic simulator had started.

The Defense Department said there was no doubt as to Congress' intent to give the President power to establish support operations and warned that since the President had usually left support operations to government elements, the Bush would be "averse to put the onus of air authority and that of the President to rest."

International Air Transport Association members agreed during their traffic conference last month in Manila on a new set of policies involving increases in fares on some routes and a hike of about 3% in cargo rates on a

- Many of the line crossings were in first class traffic. Changes are
- Some security adjustments to form within and between the Americas. New target and exposure lists are to be introduced, chiefly a document for eight or more parties traveling together.
- First class fares between Central

- América and Europe to go up \$100 tourist fares in terms unchanged
 • Increase of 70% in first class and tourist fares between South America and Europe
 • Introduction of migrant fares from some European countries to the state

- Individual increases up to 5% in Europe, Middle East and Africa despite continuation of present precautionary emission programs and reductions in some new firms.
- Little or no change in fares between Europe and India. Tonnet increase of 4-5% and first class increases of 6-7% between Europe and the Far East and Australia. No increase in direct Europe-Australia fare.
- Some increases month, first class, Asia, Australia and Pacific region.
- No change in fare on North Pacific and South Pacific routes. A 5% increase in first class fares on South Pacific route.
- No change in round trip world or polar route fares.

Caribbean carriers voted to add new tourist services within their area, but failed to agree on how levels over many sectors in the region. Current results have expired next March 31.

If the governments involved approve the new terms adopted by the conference, they will become effective on April 1. The new cargo rates will go into effect next February.

Conference members also agreed to fight three no-show problems by expediting ticketing, time limits on accommodations procedures. There will apply to passengers booking some international flights out of Canada, Cuba, Mexico and the U.S., and certain trips from gateway ports in Europe. Regulation is to become effective March.

New heads of the three BIAA trade association arms for the next year are: W. Gordon Wood, Trans-Canada Air Lines; Philip Lawton, British European Airways; and Roberto Lora, Philippine Air Lines.

1980. This is the relationship between the amount of borrowed equity and the owner's money, commonly known as equity capital, is the leverage 16
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"Even the stable electric utility industry, which does not face the competitive problems hanging over the airline industry's future, has taken a comparatively-safe ratio very close to one to one. It is one opinion that the investment community will not be willing to provide debt money to airlines on as much more liberal basis."

The financial problems of the nation's domestic airlines was outlined in the written testimony of senators and economic experts submitted as exhibits to the General Personnel Price Investigation by the Air Transport Act. Congress, all agreed that a moderate increase in fares will help ensure needed funds to pay for the purchase of new aircraft. The nation's financial problem facing the airlines today is how to finance the jet and turbo-prop aircraft which airlines must buy, between now and 1965 in order to remain competitive, according to C. Lee Wadell, president of the transportation department of the First National City Bank of New York. He estimated the overall cost to the major trunk airlines to be about \$1.5 billion at a time when the airlines are still in a loss position. The money required for modern facilities,

Adolescents can obtain the large sums of money necessary from only the following sources, he said:

- **Retained cash generation**—which is the sum of retained earnings—i.e., not in come less cash dividends—plus depreciation.

- **Outside financing**—borrowed money, or the sale for cash of capital securities.
- Wetzel and the amount of access obtainable from the sale of treasury equipment is an inseparable issue: no one can predict the future selling price of current equipment. Therefore, he added, the writers should have their forecast program on internal cash flow contain and outside financing.
- The welfare industry is a part of our free enterprise and economic and social, therefore, conspire to the capital markets of the nation for that outside financing with all other industries in that process," Wetzel said. The sales manager pointed out that the free market with credit trading is best equal to that of other industries if it successfully to obtain the outside funds.
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He said the measure of credit strength most widely used by lenders of money is what is known as the debt-equity

case. This is the relationship between the amount of borrowed money and the owner's money, commonly known as equity capital, in the business. It added:

"Even the stable electric utility, an industry which does not face the competitive problems hanging over the airlines immediately before, has today a comparable debt-equity ratio very close to one to one. It is my opinion that the investment community will not be willing to provide debt money to airlines on as much more liberal basis."

Wodel pointed out that at the end of 1959, the total book net worth of the major U.S. domestic trunk airlines was \$561 million. Simple arithmetic, he said, shows that, if the entire 52.5 per

He said financing already arranged by the industry is conditional. "In this," he added, "I mean that the ability of an airline to actually borrow the money is subject to it under its credit agreement depends upon its market."

Therefore, the belief that owner air lines have already successfully managed the money they will need to pay for their jet airplanes is fallacious since they have not arranged for it if they acquire during the years of 1955 through 1958 substantial additional equity capital.

"Today, prasaah, is a result of the sharply declining earnings of the industry; the market price of virtually all airline companies' stocks is well below their book value. In view of the airline industry's vital need for additional equity, to maintain its financial health, the fact is of great concern to a considerable bank committed to lend substantial sums to that industry. I am concerned, however, that the problem can, in the final analysis, be solved only by permitting the airlines to increase substantially their earning power as soon as possible."

Similar opinions were expressed by Gilbert H. Cordier, senior partner of Kupper, Parkdale & Co., one of the largest underwriters and distributors of investment securities in the United States.

Gordon said the aviation views the air transport industry as one in which there has been no sustainable growth.

in net earnings, although total operating revenues have grown impressively. On the contrary, he added, 1977 net earnings in the line of responding business activity will be substantially below those for 1976. Dividend payments, which for most subjects have never been substantial, are being curtailed to one-third levels, he added.

"Increased take-line competition, higher costs and the upward reliance on passenger fares portend lower net savings, even if there is no power business recovery. To add further complications, the industry is entering a period of acquiring major new equipment, the introduction of which may, at least temporarily, have an adverse effect on net savings."

like us, it is obvious there is a flight of capital from the surface. The common stock of the 12 trunk lines, for example, poured out, are now selling at 64% of their book values as compared with surface stocks that were trading at 122% of their book values in 1946, 128% in 1951 and 124% in 1948. Even in the dark days of the industry—1947—they were selling at 155% of their asset values, he said.

When leading insurance companies during the last three years agreed to loan substantial sums to several large utilities on a long-term basis for purchase of new equipment, Gordon and the design method was bright and

He added, however, that it is doubtful that the insurance companies would have made the arrangements had they realized that the net savings from would shortly turn downward and that the sale of equity securities would be more increasingly difficult.

"I believe," he said, "a more constructive regulatory climate toward the airlines is a must if the industry is to begin to attract the capital it requires. In this connection, a first measure for the airlines is clearly indicated."

The box structure must begin to erode the increases in operating costs of the squeeze on profit margins as it is corrected. Moreover, air travel growth will not suffer if the public appears to be willing and able to accept a moderate increase in the price of its tickets as it knows that the cost of everything is being cut down on their

Also included in AIA's exhibits was the written testimony of Percy S. Young, Jr., investment manager of the bond department, Prudential Insurance Company of America, one of the major investors in long-term income securities. "A healthy industry," Young said,

should allocate some portion of its earnings for growth and as an asset reserve for long downturns, we have insisted on a retention of a percentage of earnings for this purpose. Ability to sell equity-type securities is another test of a healthy company's liquidity and one of the factors which underlie the Prudent to loan to certain airlines who prove ability to raise additional equity.

However," he added, "it is obvious from the stock market record of the last 15 months that equity investors are dis-

turbed by the failure of earning power to follow the fortunes of assets in real life, to the extent that, at present, the clause for raising additional equity is not at all desirable. Should the ability to raise this equity be lost because of current disengagement, the industry would be gravely handicapped.

Other interesting testimony along such a line came from J. P. Mitchell, Chase Manhattan Bank vice president and Frederick T. Robinson, president of the National Aviation Corp., an investment company.

American Airlines Needs Fare Hike To Cover Additional Jet Purchases

By Glenn Garrison

New York—American Airlines wants to buy 40 additional jets to provide an almost 50-percent increase by 1961, but will need a 15% fare increase to handle the financing, according to C. R. Smith, president.

Fifteen more long-range and 25 medium-jetliners would cost \$200 million with related ground equipment, Smith said, and the program will depend on annual earnings of \$25 million. To accomplish that, the airline needs a rate of return of about 12% on its assets, chief executive in 1959. For additional financial security, American's operating costs as a percentage of operating revenues must be held to 93% or less after taxes.

American's present and pending assets described in testimony last week with the Civil Aeronautics Board in the passenger fare increase investigation on IAW Civil Act 7, p. 38) and were emphasized by him at a press conference here last Monday.

United would be further large amounts of capital, a 10% increase in income, declining airline earnings and a downward trend in the general economy make a fare increase essential. With the fare hike on order, Smith said, American could provide enough jet service to yield 10% on its return. With the additional jets, each aircraft would be extended to a total of 25 others by the end of 1961.

Full requirements for that time were not revealed for as actual jet orders, Smith said, because the intermediate stage jet and the long-range aircraft were ordered were placed American planned to use its fleet on air-to-air operations, shifting them to short-haul service later when the orders jet became available.

But development of the new plane proceeded more rapidly than expected, increasing the time interval between the first and second phases of Ameri-

cans' plan to fill the shorter routes quickly and other where volume service would be economically or operationally impossible. American's only remaining option required by the end of 1961 would be some 15 DC-8s.

Reasons for Increase

It thus the public, exposed to jet service on more coast segments and to long-range service on over short-haul routes, Smith said, would require a price comparable to those in Smith's view. American's present balance sheet will not be able to satisfy the public demand, he pointed out, because:

- Total equity capital of 12.7 billion out of 1961 will be required by American by the end of 1961.
- Segments of 800 or more will require 9 billion out of 12.7 billion, which will be in excess of 50% of assets.

- Because new on order will produce less than 5 billion annual net sales. If there are jets and only on segments on 800 or more will be able to raise the requirements for these two and further, would provide no jet service to seek competitive markets under 100 air in New York-Chicago and New York-Dallas.

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cans' program modernization program.

The second phase cannot be put into effect, however, unless the airline can find money to finance it, Smith said.

"We do not have that money," he told the CAB, "and the airline is in a bind at the end of 1959. Only \$125 million and it will be very little more at the end of 1957. At present fare levels, we will not see a loss in 1958 after payment of interest. Our cash flow between 1964-1967, at present fare levels, and even without depreciation on additional equipment orders—would bring us to a seriously low point. By the end of 1958, current liabilities will exceed assets. The airline is in a negative working capital position."

"The tests of our condition 10 years to one obvious conclusion: our financial position is just to get it badly. There we are in the end of 1959, we are in a bind to find the money to provide us with \$200 million of new aircraft and ground facilities by the end of 1961."

The ground facilities, Smith estimated at the press conference, would amount for about \$25 million of the total.

Regarding financing of the current traffic order, he said \$195 million was borrowed through two issues, one in 1955 from the Federal Reserve Bank and another in 1956 directed by the Federal Reserve and Prudential Life. The loans were made after determination that it would be impossible to raise more than a small portion of the money through equity financing.

American's situation at the time of the first loan, Smith said, was that its debt represented about 20% of its total capital, but over the years, actually grew for several years. CAB "had not developed a rate of depreciation which was sound," and the airline had a good record of stockholders' retained earnings.

Cash Cashes

Estimated depreciation check-off from Smith and dependent on the number of jets and the number of cash cashes is allowing for contingencies that might require additional funds to complete the initial program, Smith pointed out.

At that time, "conservative assumptions" indicated annual net earnings after taxes and interest of \$450 million through 1963 or 1961, with annual retained earnings of about \$12 million.

On the basis of American's present position, as a result of debt to total capital will stand at over 60% when the current equity program has been completely done. Interest charges, which in 1956 were \$16 million, will be \$8.25 million in 1960, and when payments on principal of the loans begin in 1967, annual required payments with interest will be over \$10 million.

Air France Borrows In U. S. for Jets

Paris—Air France will get help in financing its Boeing 707 jet purchase from Boeing Airplane Co. and United Aircraft Corp. in addition to the Export-Import Bank and the New York bonds. Management made the first time the French state airline has borrowed money in the U. S. for the aircraft.

Cash advanced 18 long-range Boeing 707s and seven more, but Smith said, would also open another \$104.7 million. The additional French government won't be a position to help out in sales, but Air France had to find the money to face its delivery position for the aircraft.

Air France now plans to pay for the 17 planes by borrowing 196 million from the Export-Import Bank and \$15 million from the private banks, at interest of 5.5% with the loans to be paid all within seven years. Boeing and United Aircraft, the engine leaders, have agreed that Air France may postpone payment of \$17.5 million due from a delivery of aircraft. Air France will not pay \$16.2 million to make up the total.

Long charges jet interest and fuel charges to expanded ground facilities such as terminal buildings and maintenance areas would total \$16 million in 1960.

The current project DC-76 poses a substantial financial risk. Smith said, but the airline will depend on the government for over 10% of the cost. The airline's current debt, at the end of 1960 would total \$161 million "at a time when they have become more cash-rich."

Enter arguments of the airline's existing fleet and Smith there while other jets "will become suddenly obsolete and will get the second-hand market in a way which will require the airline's second-hand market of 1949 since a Boeing," Smith pointed out.

American has adopted a depreciation policy which allows it to serve the fare for the Boeing DC-76, which carries more than DC-76 required later on a one and a half year basis, Smith said, and, according to American's figures, their total aircraft value remains high on the airline's books by the end of 1961 will be \$112 million.

Poor earnings, position of the airline which makes the attraction of capital so difficult is due to rising costs and falling load factors, Smith said. It is possible that the Zairebas arrangement was made as a prelude to Russia's new 170 passenger, long-range, turboprop Rassyra transport (see p. 14).

In August, 1956, a Paris American

Smith told reporters at the conference, "something more than a modest error." All business is likely to be associated with a "typical period" for a while.

Asked if reports that other American will come with its jets for only last time, Smith and Smith said, "it is very good thing" for the airline's first phase jet operation. Boeing's aircraft generally is better than current best, he added. For example, American's passenger terminal building at New York International Airport will not be ready in early 1959.

Regarding more at 100,000—where the jet is serious new grade of passenger level—Smith said, the airline's first phase jet operation, the airline's first phase jet operation and had provided that airline could be reduced. Smith's remark, he added, as to how much passenger reduction would be critical to improve it.

Smith said he felt that airline would be done by "impossible" level by 1959, although he couldn't be sure "agencies" really return the same thing to American that it does to the rest of New York's airlines. Executive Director Martin Tolan.

Russia Suggests U. S. Bilateral

Washington—Soviet Union last week suggested that it is ready to negotiate a bilateral or government with the U. S. for direct airline service between Russia and the U. S.

Gregg N. Zarebas, the Soviet representative made this proposal here during his visit to Washington with Soviet Ambassador Willem S. B. Lacy on the expression of exchanges of ideas and information between the two countries. In a prepared statement, Zarebas said:

"The Soviet side is also ready to reach agreement in principle on the establishment of direct air communications between the U. S. S. R. and the U. S. A. on a basis of reciprocity."

Understand that Russia would also seek a bilateral agreement with the U. S. was disclosed as an Aviation Week article in Moscow last year for the Soviet DC-76, which carries more than DC-76 required later on a one and a half year basis, Smith said, and, according to American's figures, their total aircraft value remains high on the airline's books by the end of 1961 will be \$112 million.

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In August, 1956, a Paris American

The American official said that if CAB didn't grant the fare increase, the airline would probably have to take steps to sell its assets if it had to be and through the Board will be available.

The airline's program could not only have been delayed until the last possible moment for competitive reasons, Smith said, but it was being made public because there was no other way of bringing to CAB the full extent of American's financing problem.

Stanley Gewirtz Resigns National Vice Presidency

Mt. Air—Resignation of Stanley Gewirtz as vice president of National Airlines was announced last week by G. T. Baker, president and board chairman.

Gewirtz at a recent vice president of Air Transport Association and executive assistant to two chairmen of the Civil Aeronautics Board. He had Airline's Washington office and was not announced at a later date.

World Airlines controversy caused Aeroflot officials in Moscow in response to an invitation to discuss Moscow operating rights for Pakistan (AW Aug. 27, p. 25). Negotiations were held and have not been announced.

Gen. Belcher explained during the American Airlines conference that American's bilateral policy is based on reciprocity. He said the Soviet airline reports to fly in its countries in which a great traffic exists. The bilateral program is now being set up in North America, Western Europe and Asia.

East German Transport

Moscow stage jet transport received, reportedly sold both by East Germany will be completed by May. The transport, previously designated the EastGerman B-151 will be made in late 40 and 70 ton versions.

The aircraft will come at 200 tons and have a 150-ton weight. It has four jet engines developing a total of more than 27,000 hp. It may be the first East German B-151 as roughly the same size as the East German B-151. It has also the same construction capacity with more thrust and a higher climb rate than usual.

Most striking, these units are the B-151 in its design as a take-off from the ground and a take-off from the ground of 4,000 ft.



Operation Call and Haul

During Exercise "Call and Haul" at Fort Riley, Kansas, 45 U.S. Army Officers of the 3rd Company moved 300 fully equipped combat troops of the 16th Infantry a distance of 35 miles in 10 minutes.

Subsequently, 10 Officers chartered 20 tons of ammunition and supplies into an improvised "battle field" landing strip in a 45 minute period.

The Otter carries a crew of two—over a ton of payload loads in less than 600 feet.

6-27



The Otter—Designed and Built by

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW, ONTARIO

over was 1.65. The average margin of others was 3.15.

With an average margin of return of 3.15, a 7% decrease in revenues or a 3% increase in expenses would reduce the margin and rate of return close to zero. Duane was such a large depositor of risk coupled with a reliance on fees actually increases with the industry's ability to arrest a downturn at considerable low cost.

On the other hand, he added, some transportation utilities with a wide margin of return tend to be less volatile because earnings usually remain fairly stable in the face of any given change in revenues or expenses. To the latter test, he said, their relative apparent safety substantially counterbalances the fact that revenue regulations makes the chance of any such a catastrophe. In states who feel fairly assured of a continued return within conservative limits and who feel confident that they will not lose their capital investment do not demand undervalued rates and possibilities in their return, Duane said.

Los Angeles Terminal to Expand

New passenger terminal complex provided for an expensive plan for Los Angeles International Airport consists of 15 buildings of major proportions in the 200-acre area. Existing buildings are located around the perimeter of a 5,000-car parking system. Located on the ramp, and worked by underground channels, are the satellite buildings whose passengers will capsule and airplane.

Each of these buildings will measure 300 x 175 ft., large enough to cover a football playing field and each will have a waiting room, coffee shop, news and gift stand. Satellite buildings also will have 10 plane loading positions suitable for the coming jet transports.

Each will have another level and a maximum above ground. Plans for a center complex have not been started, but arrangements for the ground scheme likely to be followed.

are progressing. Center complex will contain a restaurant, medical lounge, coffee shop, employee cafeteria and commercial shops. Spurred leading from central complex to buildings around perimeter are elevated walkways over the parking lot, which is one story below the field level.

First stage of tailoring buildings around perimeter are fields with the parking lot, second story is built over the field level. In the first quarter of 1958, work will begin on underground construction, under spans and on paving of spans. After this, work will commence on reducing buildings and satellite structures.

Next will come the central area which includes the main buildings and parking.

Peeters and Lockman are coordinating architect in a joint venture which also includes architect Wallace Barkley and Associates and Paul R. Williams.



Boeing Stratoliner Rolls From Plant

Number one Boeing 707 Stratoliner jet passenger liner is rolled out of Boeing, Wash., Transport Division plant, near Seattle on Oct. 28. Photo at right shows the 80,140 passenger aircraft shortly before rollout date. The structurally complete plane will undergo final functional testing before being flight tested. This plane will be delivered to Elia Amersbach World Airways delivery is scheduled for late 1958 (AW Oct. 28, p. 125). The 707 is expected to have a cruising range of 5,000 mi. and speed in excess of 600 mph.



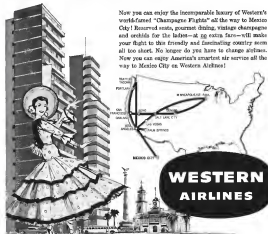
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**WESTERN
AIRLINES**

SHORTLINES

►United Air Lines will begin daily Douglas DC-7 air coach service from Boston to Chicago and Los Angeles on Nov. 12. The new flight, called "Custom Coach" service, is scheduled to leave Boston at 9:45 A.M. EST, and arrive in Los Angeles at 5:25 P.M. PST, with an en route stop at Chicago. The return "Custom Coach" flight, scheduled to leave Los Angeles at 11:30 A.M. PST, will arrive in Boston at 12:14 A.M. EST, flying by way of Chicago and New York.

►Continental Air Lines has doubled its Douglas DC-7B air coach service to Kansas City on the Chicago-Los Angeles route. On the new schedule, the airline's "Club Coach" Flight Five is scheduled to leave Chicago daily except Wednesdays at 2:30 P.M. CST, adding Kansas City to the flight, arriving there at 4:15 P.M. CST and continuing on to Denver and Los Angeles. Returning to Chicago, Flight Five will stop daily except Tuesdays at Kansas City at 6:20 P.M. CST, continue on to Chicago, arriving there at 8:25 P.M. The new Kansas City service is in addition to the daily stops to that city on Flight One Westbound and Flight Four Eastbound.

►KLM, Royal Dutch Airlines, has increased its flight operations to Europe, the Middle East and Asia. KLM now has 14 weekly flights to London, seven to major cities in Germany, five to Paris and five to Brussels. KLM also has extra cargo capacity of up to 15,000 lb. a day in its freighter, plus twice as much baggage as combination cargo/passenger aircraft.

►Pan American World Airways is completing the purchase of a 20% interest in Philippine Airlines. The purchase was made subject to Civil Aeronautics Board approval, at the instance of Philippine Airlines president Col. Arden Serrano, who asked Pan American to become associated with Philippine Airlines through a purchase of part of its holdings. Pan American acquired approximately 4% of PAL's stock last August.

►Flying Tiger Line reports a net income from operations for the third quarter of 1957 of \$497,445 as compared with a deficit of \$115,374 for the same period last year. Net income and operating profit for the third quarter were \$3,801,575. Gross revenue for the period was \$9,465,637, or \$5,170,575 resulting from introduction of the new Lockheed Super-H Constellation on Flying Tiger's routes last June.

AIRLINE OBSERVER

►Convair is increasing local service airline interest in a turboprop conversion of its C-74-340-440 series. Most local service airlines are determined to shift to turboprop power when they change from the DC-1 and the turbo-fanjet hopes to attain its hold on the short haul market through the conversion. Northwest Airlines already is considering jetting engine version of the 440 as a possible replacement for its fleet of DC-1s.

►Aeromexico de Mexico's first Bombardier, which arrived in Miami last week, is assigned New York International Airport to avoid the 10% New York City sales tax. Price of the plane is about \$3.5 million. Second Bombardier is due in Miami in two weeks.

►Airline stocks generally continued to lag when a low point of 1957 lows despite the recent stock-price upsurge of market prices. However, as the market slipped back to lower levels last week, however, airline stock rose slightly and new lows for the year were avoided.

►Russia's new, long-range Kosyov turboprop transport scheduled for unveiling in the near future, is expected to make sharp inroads in trans-Siberian rail travel. Soviet Air Force Major Gen. A. Mikoyan says a 170-passenger Kosyov, operating only 100 hr. a month on the Moscow-Vladivostok route, will be able to replace 16 trans-Siberian passenger trains.

►Times World Airlines' pilots have been given a new vote in operational matters under a policy introduced by President Carter Bagshaw, now feel they are given a free chance to participate in company decisions on flight time schedules.

►Lack of serious analysis has forced Civil Aeronautics Board to go against its own wishes and defer the local service Rate of Return Case. The Board denied an earlier hearing request for defendant on grounds that the carrier had spent much time and money in the profitability of this case and that a further delay might under the carrier's "side." However, because concern's plea that its service market who was to be the chief witness, has left the Board's capital and that the number of serious analysts has decreased from ten to two in less than a year leaves the CAB with an alternative but to postpone procedural dates.

►Northwest Airlines hopes to expand its operations through interchange of equipment agreements with other airlines. Prior to the Civil Aeronautics Board's denial of Northwest Airlines' petition to discontinue the National Capital interchange agreement, Northwest said the Board's decision, in allowing to enter such a pact as its Washington-Nation route if the National Capital agreement were dissolved.

►Swiss Air Lines of Spain, and Swissair feel their Concord Metropolitan 440 flights are having an effect on competitive British European Airways' Viscount flights over European routes. Both airlines are experiencing a reduced net in load factors on the Geneva flights after a prolonged and disappointing intercompany period of low traffic levels.

►Pan American World Airways' plans for jet transport operations include streamlining of its flight service based on a long-range test program. Plans call for the usual service of 180 passengers in 18 minutes with another 35 minutes for cleanup. The carrier has been taking and installing a full complement for the past several years as part of the program. Quick-turn techniques are being further developed. The airline plans to let its jet flight service to an "international hospital" theme and is expanding its logistical requirements for in-flight personnel. About 75% of its flight crew personnel are now in the group.

►Northwest Airlines has been found to meet all foreign-air equipment requirements for the LaGuardia terminal terminal by the Marine Base at the New York Airport because of overcrowded conditions in the terminal and the terminal terminal and lack of gate space. All foreign-flight will continue to operate from the LaGuardia terminal which means the airline is required to maintain duplicate ticket counters and passenger-service facilities for its New York operations.



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Switch 1000 Series—Standard 1000 Series switches have 100% reliable performance at 100° to 150° F. They offer maximum shock resistance at 100° to 150° F.

Actual Size

1/2" x 1/4" x 1/8"



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Actual Size

1/2" x 1/4" x 1/8"

Standard switch has 1/2" leads



SUB-MINIATURE BASIC SWITCHES

824-100 Series
Electro-Snap—Standard 824-100 Series switches have 100% reliable performance at 100° to 150° F. They offer maximum shock resistance at 100° to 150° F.

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Actual Size

1/2" x 1/4" x 1/8"



BASIC OPERATING CHARACTERISTICS

(Sub-miniature Switches 824-100 Series)

Weight—204 lbs.
Max. life ratings—100,000 ops.
Elec. life ratings:
100-800 ops. @ 125-150 V, AC—0.5 amps.
100-800 ops. @ 125-150 V, AC—0.5 amps.
100-800 ops. @ 30 V, DC—0.5 amps.
100-800 ops. @ 30 V, DC—0.5 amps, 100.

Approved on QPL, 824 & 827 in accordance with MIL-STD-883B, II, Approved.

TOGGLE

Standard on Memory, with position for Standard on Toggle Pole

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)



1/2" x 1/2" x 1/8"

PUSHBUTTONS

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)

Welding type of Pushbutton, Standard for All Applications.



1/2" x 1/2" x 1/8"

LEAP

Standard, Standard Switch

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)



1/2" x 1/2" x 1/8"

ROTARY ACTUATED, GANGED, SUB-MINIATURE

Standard on Memory, with position for Standard on Toggle Pole

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)



1/2" x 1/2" x 1/8"

ACTUATORS for Standard, Environment-Proof Sub-miniature Switches

Standard on Memory, with position for Standard on Toggle Pole

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)



1/2" x 1/2" x 1/8"

ROLL-READING PUSHBUTTONS

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)



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LEAP

Standard, Standard Switch

Single Pole
Double Pole
Triple Pole
Quadruple Pole
Five Pole
Six Pole
Seven Pole
Eight Pole
Nine Pole
Ten Pole
Eleven Pole
Twelve Pole
Thirteen Pole
Fourteen Pole
Fifteen Pole
Sixteen Pole
Seventeen Pole
Eighteen Pole
Nineteen Pole
Twenty Pole

Switching time, above models, 100° to 150° F. (Also available in 100° to 150° F. and 150° to 200° F.)



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Leduc Ramjet

By David A. Anderson

Aggenetot, France—Work on the second prototype Leduc O-22 swept-wing and interceptor, nearing completion and scheduled to fly early next year, takes a threefold acceleration by an economic-minded French government.

In spite of the magnitude of the technical contribution made by the relatively small Leduc organization, plans are under way to eliminate the O-22 along with some other promising prototypes from the lists of government-supported projects (AVI Oct. 7, p. 31). This proposal arose from the French industry is similar to the British White Paper of last spring, which hurled the British industry into the outside business in spite of itself.

But in view of the illustrated French military requirement for an air interceptor, it seems strange to include interceptors that the Leduc work should be cut back.

This second prototype O-22 is the seventh in a series of six-cylinder swept-wing aircraft developed and built by the firm of René Leduc et Fils. It is the last of the projects designed with a military requirement in mind although it is not yet authorized by any specific government agency, nor can it be considered as a part of a weapon system at this stage.

The second prototype is similar to the first O-22 now on flight status at the government test center at Istres in the south of France.

Sophisticated Brute

The Leduc O-22 now flying is a brute of a machine compared to the sleek delta appearance of the early experimental aircraft. The large cylindrical fuselage, with two spike thrust for forward thrust, dominates the layout. The two swept wings and tail surfaces seem added as afterthoughts.

Overall length is about 57.7 ft; height is about 17 ft. The wings span 10 meters, or 33 ft, and are mounted on the fuselage structure. Approximate total wing area is 253 sq ft. Main flaps and ailerons are about 25% of the chord. Large slats at the intersection of the wing trailing edge and the fuselage serve to house the retractable landing gear. The wings carry streamlined banks of high frequency ratio which probably double in a matter of getting the central axis forward and cutting down any tendency of the 9% wing surface to buffet.

Interceptor Project Faces Cancellation

The tail surfaces are also distinguished by top finning, also probably serving as anti-flicker devices. Thickness of the tail surfaces is 5%. The horizontal tail is mounted just below the fuselage structure (with considerable setback). The surface is a delta and is covered by movable leading-edge slats developed by Jacobin Leduc.

Stepped into the landing gear is used and there is a fourth wheel serving as a tail braker.

Flying Powerplant

Essentially, the O-22 is a flying powerplant with lifting and control surfaces, a cockpit and landing gear added. At least three possible design conversions have been made to get optimum engine performance.

The engine begins actually at the sharp point of the nose spike that generates the first bow shock wave at supersonic flight. This spike stretches far enough ahead so that at high supersonic speeds the rest of the airplane lies completely inside the Mach cone, so that the flow is above the spike there is a constant change for the cockpit. Just forward of the altar is a small circular scoop which is the boundary layer bleed.

The tip of the scoop generates a second defined shock wave which, over the design speed range of the O-22, first sweeps up as the nose rises by and then moves downstream as speed increases. Inside the cone this air flows further to a Mach number around 1.2 at the maximum compression just downstream of the altar. The control tank, near the throat section, is porous for fire control. This control tank, across the diverging portion of the environmental area and adiabatic diffusion follows.

Mounted in the center of the face is a single Sorensen Air D10 turbojet engine. In thrust it used for the design-point portions of the O-22 flight profile—takeoff, landing, cruise and acceleration to ignition speed. Starting at its exhaust nozzle and continuing outward along a conical surface are five rings of smaller burners of the target engine. They have a minimum diameter of approximately 5.4 ft, and the landing diameter is 6.86 ft.

The target exhausts through a convergent nozzle.

Structural Composition

The structure of the Leduc O-22 is not immediately comprehensible, for

the simple reason that almost everything in the airplane has to be capable of being built in the Leduc facility. For this reason, forgings and other high production components just aren't used.

Because of the desire to get maximum engine-to-structure performance out of the plane, Leduc engineers have not been able to get much in the line of all the shell components.

The small wheels and links don't rust, except engine components have been built in stainless steel. Engine components were for turbojets and piston engines, not for increasing the fuel flow through a line that divided power between fuel conductors. So Leduc still

designed, and his counterpart ship built, a complete assortment of components.

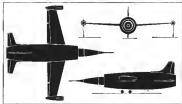
With the exception of some extra struts, the tires, bearings, plugs, valves and such small parts, everything on this airplane and the ones before it has come out of the Leduc shops. This is probably unique in contemporary aircraft design.

Integral Refueling

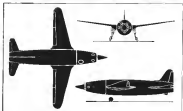
Wings of the O-22 are unified from start to end and integrally stiffened. The company's new practice has been a feature of all the Leduc experimental airplanes including the first O-16, which means that Leduc has been building integrally stiffened wing skins for a de-



DIAMONDS of Leduc O-22 swept interceptor now being set overall length, 57.7 ft, height 17 ft, wingspan, 33 ft. Approximate total wing area is 253 sq ft.



FIEST free flight of Leduc O-22 took place Aug. 7, 1951. Sea level rate of climb for O-22 was estimated at 40,000 fpm; estimated ceiling was 45,000 ft.



LEADER O-16 was first prototype to be airborne. Flights began in November 1946, first captive as a Langmuir transport, later with the O-16 cut off as a glider.



FUEL control system for the Leotec O-21 (left) was designed, built by Ben's Industrial Staff.



Accessory gearbox for O-21 is at right.

ade, meant years longer than most everybody else.

"The wings are made on upper and lower halves on a huge Swiss-built La Rodee horizontal miller designed according to Ledet's requirements. The miller is being used by Ledet on some subcontract work for other firms in the French industry, the machine was bought for me by the French Air Ministry.

The miller is the pride of the Leotec shop, which is not over equipped by U.S. or even French standards. The shop visit resembles an experimental shop anywhere in the United States during the war. There is a small number of competent technicians and mechanics who have been in the business long enough to make or duplicate any part by hand or with elementary tooling, there are specialist machinists who

fabricate the high-tolerance parts for engine control systems, there are electric welders and assembly blads. Parts and tools are everywhere.

In one corner stands the giant ductwork of the second prototype O-21, just beginning to take respectable shape. Of dubiousity in the other corner is the enclosed outer shell of the jet engine for the same ship. Next to it is a cockpit mockup and a turbine-driven model of the airplane that was used to flight-test the engine section.

Wind Tunnel

Across the street and through a storage yard is a building which houses Ledet's expensive wind tunnel. It's a subsonic type, discharging flow at atmospheric inlet to a battery of vacuum bottles.

Size of the test section is about 11

in square; there are four nozzle blocks for Mach numbers 1.3, 1.75, 2.0 and 2.3.

Three water-cooled section pumps have the capacity to evacuate the vacuum tanks for a run even half hour. Test data includes standard static measurements—like drag and pressure moment—plus pressure distributions and turbulent observations or photographs.

I saw a test run on the diffuser inlet at Mach 2.3, flow in the test section was very uniform and there was no evidence of apparent shocklets caused by manufacturing errors or design inaccuracies.

The bomb-baited section system produced a well-behaved, high-quality pressure.

As with the Leotec airplane, almost every part of the tunnel has been designed and built by the staff, including the balance system, manometer board and the airlocks.

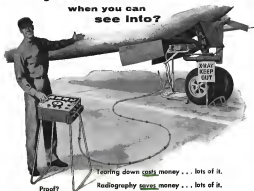
Lengthy Career

More than 24 years have separated Ben Ledet's early studies from the achievements of his current airplane. Striving in the depths of a world-wide depression, his work has sustained a way to invention, his imagination and his pigged government, positive reconstruction and a subsequent altitude that has driven development costs in the aircraft business almost out of sight.

Ledet's first serious proposal for a completely new aircraft was made in 1913, with a basic design almost identical to the first prototype airplane flown a year later. His preliminary studies of the wing began in 1914, with three ribbed analysis supplemented by tests made in a vacuum system with a five engine. The following year Ledet was able to construct a positive thrust for the first time in his development work, but the construction of the engine was irregular and painting.

Specific studies made by Ledet in 1918 included overall weight analysis, work on construction and design calcu-

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WINGS of the O-21 are milled from alloy steel and integrally stiffened. This process, previously developed by Ledet for a decade.

speaking of
reducing...

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weston
pneumatic
pressure
reducers

give you
up to
1000 scfm
at only
1.87 lbs./l

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Inlet Pressure—2000 psi
Outlet Flow—Up to 75 cfm, 1000 SCFM
Outlet Pressure—As required—200 to 2000 psi
Outlet Pressure—115% of Outlet Pressure
Maximum Leakage—5 cc/min standard air
Ports—1/2 inch tube size
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In 1956 he continued the theoretical work, extending his studies to a non-speed concept and calculating performance of a series of diffusers in which the cross-section varied as a function of a constant times the inlet air mass times the quantity one minus Mach number squared.

Parallel to these studies he continued engine testing.

This last phase of his work ended in June 1958, by which time Leduc had achieved stable combustion and had completed an official test on the engine witnessed by engineers of the French aviation industrial service. These runs were made with an engine of 1.3 in. inlet diameter and 1.5 in. exit diameter. Free-stream Mach number was 0.967. The recorded thrust was 5.4 lb. and the fuel consumption was measured at 2.34 lb./hr. (10.4 lb./hr.)

Official Recognition

The following year the French Air Ministry gave Leduc the order to build and test his prototype engine, eventually approving the language program he had laid out for a series of steps leading to manned supersonic flight in a military reconnaissance. Leduc was assigned available space in a Breguet plant and moved in.

Series construction and test work on the first prototype O 10 began in 1958. Complete mock tests of the plane were made on the Ford lathe-turret, producing the detailed design of fuselage lines. Wing and control surfaces on the drawing boards. A one-fifth scale combustion chamber was built and tested over its expected operating range. Wing profiles of 6.25% and 12.5% were hand tested at Mach numbers of 1.6 and 2.35. Efficiency tests began again in 1959 toward its defining specific loss for the prototype aircraft.

About this time, Leduc and his engineers began another unusual program. An elevated development of a gas turbine to drive the pumps and accessories for the engine and airplane. The state of the gas turbine art at that time was very sketchy. The Germans had to build and fly an aircraft gas turbine, had several months to go before getting into the air. Frank Whittle in England was deep in development testing and proof of his design. In Italy, Generali was working toward a 1946 flight date of a rocket-driven ducted-fan engine.

That, plus the experience of builders of large heavy gas turbines for stationary powerplants, was about it. Leduc drew into this problem and in 1949 had his gas turbine running and doing acceptance.

The six weeks' air flight Leduc with completed engine combustion

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chamber and gas turbine and no particular desire to bend them over to the visiting forces. With a few of his staff, Lohde took off for England, taking his voluminous briefcase, drawings and technical data with him.

He might not have gotten away with it, had the Germans been acquainted with the caliber of his work. But post-war interviews with some of the German specialists in Germany showed that they knew of Lohde and his efforts, but considered him crazy and his work as nonsense.

Work Continues

Lohde kept after the Vichy government during the occupation and succeeded in getting a green light from them in 1943 to continue work that had almost been banished in 1944 and actual portions of the work were destroyed.

In August that year he started again on the O 10 and completed the airplane the following year in a first atmospheric trimmings ground checkout test, demonstrating so that the engine did not get into the air until 1946. Since its only engine was the rocket, which was self-ignitive until a moderate speed had been reached, Lohde decided to attach the plane from a framework strutting on top of a Langford two-engine transport designed before the war in Munich. He now (now Germany) and entered into production in 1941 by Vichy for the Germans.

Flight tests began in November 1946, first engine on the Langford and later with the O 10 in itself as a glider during a shallow dive at the carrier plane. Many flights proved the upstart notion and the controllability and flight parameters of the Lohde craft.

First Flight

Then on April 21, 1946, Joe Goetz checked the ladder from the Langford wing to the two capsule cockpit entrance of the Lohde O 10 and appeared in. The four piston engines of the carrier belted and the composite craft lumbered from its husband to the runway.

At 13,000 ft., Cal. Peña, now on the Lohde staff, dropped the nose of the Langford below the horizon and began the shallow dive for acceleration. Ground in the O 10 talked to Peña, told him he was ready to light the engine and cut loose.

Above the Langford, the huge magnet engine came to life with a roar, its bright yellow flame tinting the visible surface of the carrier. The run was steady, the flame short, the speed right.

Peña and Goetz checked instruments once more, spoke briefly over the radio link between the planes. "All set," the plane reported, the O 10

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Soviet Short-Haul Plane

Soviet An-14 Pobeda (Little Bird) was designed by O. K. Antonov for short-haul airline service (AW Aug. 18, p. 36). Six-cylinder, two-engine plane can carry mail, light cargo and perform aerial photography, rescue missions, other tasks. Aircraft weighs 12,514 lb. empty and is able to fly on one engine. Pobeda can land on a small field, and its very open wing 40-ft long. Plane is equipped with instruments for blind flying at night flights, has relatively high ceiling. Aircraft will be available for operation into Russia's postal air service.

lifting and the Langendor dropping like a stone.

Ground pulled up and away to the left, with the engine a steady beat behind him. On this first flight he took it easy, turning on one set of burners after another and accelerating to 450 mph. Nine minutes later he wheeled the Q-10 around into a glide and returned slowly to base.

On later flights with the same plane, General reached 50,000 ft., breaking Mach 0.84 in the climb at 24,000 ft. The rate-of-climb indicator was still showing 40 meters per second, which converts to just under 7,500 ft./min. Fuel consumption was 3.15 lb./hr. throughout at Mach 0.84.

This was about the maximum performance of the first prototype.

Next Prototypes

The first two prototypes Q-10 aircraft, which were essentially identical externally and internally, were followed by the Lebed Q-16. This was basically the same as the Q-10 beam, but a pair of Turbofan Markov 3 turbojets were fitted at the wingtips by request of the pilot.

These were used during the flight test program, but later abandoned and replaced by turbojets. This version was cleared for flight only in 1952.

Construction of a pair of Q-23 prototypes was Lebed's next project. These were larger aircraft, their engine derivatives were 4.75 ft. compared to the 5-ft. figure of the Q-10. The first prototype, finished at the beginning of 1953, began its captive flight tests in May

that year. The faithful Langendor was still the owner.

First test flight of the Q-23 took place on Aug. 7, 1953. The second prototype Q-23 flew under its own power the following March 1.

During this series of flight tests, Lebed test pilot Ivan Linnik recorded speeds of Mach 0.91 and a maximum altitude of 46,000 ft. The climb performance of the aircraft was outstanding. The sea level rate was estimated at 46,000 ft./min., and a measured figure at a rate altitude of 15,400 ft. showed the plane to be climbing at 15,700 ft./min. Estimated ceiling of the plane was 65,000 ft.

Air Ministry Support

The French Air Ministry has supported Lebed's work in what is probably the largest single airplane development program in history. During a brief hiatus during the occupation, development funds have continually been forthcoming for the Lebed effort.

T2V, WV-2 Outbacks

Washington—Immediate reduction of 100-400 Lockheed Anson II Corp. employees will result from cutbacks in production of T2V-1 and WV-2 aircraft ordered by Navy.

Cutbacks will reduce Navy spending by \$11 million in fiscal 1958. They eliminate 15 WV-2 ships each winning contracts due for delivery next year and 100 T2V-1s. Budgetary cut measures, 81 of which were to be deferred this year.

Nobody can deny that is a long-term project, but some observers have questioned whether or not it has been too long a time. They cite the fact that France has now several suppliers flying with Mach 2 passenger and that Lebed has therefore lost the technical lead he obviously had.

The answer to this criticism lies in the unique powerplant itself. Light on weight, producing enormous thrusts for low drag, and capable of operating on a variety of fuels from low grade oils to exotic, extremely refined jet-fuels, the unique engine furnishes a powerplant of extreme versatility. It has one major drawback, it has to be boosted in some speed sufficient to light off. It produces so strong thrust cannot be used for takeoff in a conventional manner.

Booster Problem Solved

But combined with an external jet booster, the unique takes on new life. Thrust-weight ratio can still very low, and the booster problem is solved. Furthermore, the fuel consumption of the combination still shows advantages over a solid-propellant rocket of comparable weight in cost or complexity. This opens stage at later time in a single shot.

These factors all add up to one conclusion: the rocket-boosted combination is an excellent powerplant for an aircraft.

France's obvious defense need is an advantage. Current deficiencies (AW Oct. 7, p. 31) are that the wing will be solved first with the Dassault Mirage 5.



On the J-79 Engine for the Fast, New F-104, Aeroquip 601 Lightweight Engine Hose

SAVES WEIGHT Aeroquip 601 Lightweight Engine Hose offers weight savings of 44% in the —10 size, compared to standard MIL-H-8794 hose. Other sizes are similarly lighter. The resultant weight savings contribute to higher performance and speed required for today's—and future—aircraft.

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Carrier's Bulk Dwarfs Demon

Huge bulk of USS Santiago (CV-60) dwarfs a McDaniel PHE that has just been towed from the dock at the mouth of the San Pedro Channel. Photo was taken during carrier qualification operations near Gothenburg Bay, Calif.

a deltaranged pipe with a powerplant combining a large footprint with also having plus a smaller liquid rocket engine.

Next step in the solution could be an advanced 3rd Avionics Trident (AW Oct 7, p. 31). On the next step could be a reprogrammed L-1011. Or it could be a new aircraft, although even the most latest generation of aircraft may be beginning to look off on evaluation dates of operational response.

Long ago, says the French Air Ministry technical experts recognized the future potential of L-1011's ideas. Their continued backing has been the result of engineering support, not behind peak-banking. They saw then the possibilities of advanced flight interception with dash speeds since Mach 3. After the war in the long needed sense of progress, L-1011's work was spared for technical reasons. It has remained solid today, solely on that basis.

Increased Magnesium Use Forecast

New York—Magnesium's relatively high heat transfer characteristics and ease of manufacture will make it more popular for an increasing number of aircraft and missile parts despite the higher temperatures of hypersonic flight, according to speakers at the Magnesium Association's annual convention here.

Value of high heat transfer rate has made it more attractive for Magnesium Aircraft Co. Van Nuys, Calif., in its magnesium alloy coated with heat resistant paint for those domestic aircraft which must meet the needs of the standard steel. A spokesman for Magnesium told AVIATION WEEK that it may be possible to use magnesium alloy even for certain parts of the Boeing 747, Boeing is said to be planning, such as Mach 4.0 bomb-resistant nacelles and even ICBM airframes. Skin temperatures in these applications will now reach 900°F.

According to another materials expert at the meeting, and manufacturers

is too low in some areas, its own heat, if the part is of a certain size, while magnesium with variable section properties can readily be cooled from the inside.

A paper by John H. Bales and Robert P. Nicholas, two General Motors engineers, raised the conference, however, that unless magnesium developments are able to keep pace with progress in other materials, the slight advantages which magnesium offers now hold on a strength-to-weight and stiffness ratio basis in the 300,000-psi range may be lost. At present, magnesium is most attractive for parts such as electronic chassis which must be both light and able to dissipate heat, according to these engineers.

Recent manufacturing developments, which make magnesium attractive demand at the machining level.

■ New 13,300-psi General Motors extrusion grade now being operated by the

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U.S. Patent 3,709,110



This shock absorber, Shindler believes is part of the landing system of the Douglas C-124A. Inland notes the dual military transport's emergency engine crash, the Shindler just now remain flexible despite severe operating temperatures.



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Dow Chemical Co. at Midland, 11 Dow says they are able to use as large as 3,900 lb. agents to produce long service lifetimes up to 93 ft long or 18 in. diameter. When used in inside and outside wings and landing gear, the system will reduce both the flexing and the weight of the structure.

• **Provisioning** of suspension by firm like the Oshkosh Corp., Los Angeles, was done by L. H. McCann of Chem-Vought Aircraft Inc., Dallas, Tex., to have used his company at least \$3,300 per mile when used on an outer wing panel.

• **Provisioning** at McDonnell Aircraft Co., St. Louis, Mo., which consists of placing a heated preformed blank into one half of a 510 000° heated casting die, bending down the other die half, and then applying sufficient pressure to make the metal flow. Magnesium and aluminum can be present. Pressure is reversibly proportional to web thickness with minimum web spacing 40 in. as compared to 20 in. for other alloys.

One distinct advantage of the process being technique is that no duct aluminum and be made and McDonnell has been able to make 3 in. high ribs in this 0.008 in. web.

Other production techniques discussed at the meeting were chemical milling, large forging presses and die casting and high-rate machining.



Material Simplifies Electrical Products

Westinghouse Electric Corp. has developed a new type of carbonized magnetic core material which can be magnetized in four directions, having electrical components drawn from the necessity of building core assemblies up from many separate packages with the mechanical bracket parts and flux line across the joints. As the electrical engineering illustrates, the carbonized crystals are lined up in the same direction. Therefore all these are of easy magnetic core.

Civilian Test Pilots Form Flight Council

Civilian test pilots at the Air Force Missile Development Center, Holloman Air Force Base, N. M., have formed a test pilot council for the purpose of achieving and maintaining sound and effective procedures for both flight safety and flight tests. The council is currently reporting a first step progress outlined by Gen. L. T. Damm, commander of the missile development center.

Membership includes engineering and experienced test pilots from

Hughes Aircraft Co., Convair, Bell Aircraft Corp., Douglas Aircraft Co., Convair Aircraft Corp., McDonnell Aircraft Corp., Lockheed Aircraft Corp. and Northrop Aircraft Inc.

Officers of the test pilot council are: John B. Binsfield, Northrop, chairman; William Mable, Bell, secretary; Raymond Hunt, McDonnell, treasurer; Richard Kohnen, Lockheed, vice chairman; Dave Mitchell, Goodyear, assistant secretary; and Roger Delahunt, Lockheed, assistant treasurer.

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Crew: pilot and GPL

Today, military fliers in planes equipped with GPL auto-navigators, have another "max" on board—guiding the plane with pinpoint precision, working automatically, continuously, without fatigue.

These GPL self-contained auto-navigation systems—developed in conjunction with the Air Force (WADC)—instantaneously display Ground Speed and Drift Angle, Wind Speed and Direction, Longitude and Latitude, Shortest Course-to-Destination, Steering Signal to Pilot (or autopilot).

The benefits of GPL airborne auto-navigators extend to every area of flight. Their vast potential has just begun to be explored.



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ENGINEERS — GPL technicians have opened up vast uncharted territory and development opportunities. Just ahead is Personal Manager.

Canadians Study ICBM Exit, Re-Entry

Montreal, Canada—A team of scientists, mathematicians and test engineers, and design details of higher performance rockets, were among the subjects covered at a joint Canadian-American technical seminar and symposium on ICBM re-entry and exit, held recently at Montreal, Canada.

Gap between ICBM performance and test equipment was discussed by G. W. Buck, K. R. Bollenstein and G. H. Tully of the Canadian Aerospace Research and Development Establishment (CARDE) in demonstrating present methods for ground simulation of ICBM flight, the authors described their work with the CARDE aeroballistics range, showing how this could be used for problems such as stage separation during ICBM boost out of the atmosphere.

In the CARDE design a light gas gun using a hydrogas-oxygen mixture and with hydrogen in the working fluid is used to launch 4 m. diameter models into an evacuated range. A dummy chamber is used to trap the heated hydrogen gas following the projectile and to direct it outside the laboratory. The range is 2 ft. in diameter and 60 ft. long. It is instrumented with two-dimensional x-ray photographic stations to measure the trajectory.

Gas Controlled

Gas inside the range can be controlled in pressure, temperature and content.

Although the firing range is readily controlled, the authors said that observation and recording problems are extremely difficult. Moreover, the types of models are limited by the large launching loads. Models in the order of a few grams can be launched at velocities up to 25,000 ft./sec. (about Mach 30), but heavy models (weighing in the order of a few pounds) can only be fired at Mach numbers as high as 20 by using a heavy gas atmosphere such as bromine.

Overcoming the present lack of fully developed ICBM test facilities, the authors concluded that current ICBM aeroballistics problems will continue to be mainly solved by expensive test firing techniques.

Concrete suggestions for designers of efficient engines with high specific thrust, low frontal area, were offered by two National Advisory Committee for Aeronautics researchers and an engineer from Canada's Ingersoll Ltd., Canada. Future subjects, according to these authorities, may well center the following:

• Thrust-to-weight

• High flow capabilities.

• High weight-to-weight.

W. H. Robbins and H. W. Mohr of the Lewis Flight Propulsion Laboratory, Cleveland, O., said NACA has run a transient compressor which achieved 4.48 pressure ratio per stage with a mass flow of 10 lb./sec./sq. ft. and a peak efficiency of 0.9. Relative Mach number at the blade tips was 1.1. Then, they said, was an aerodynamic increase of 20% over that for conventional subsonic compressors or, in other words, one transient compressor stage could do the work of two conventional subsonic compressor stages.

The transient compressor represents a major advance in the compressor field, according to NACA, as it will enable the designer to increase the

airflow capacity and stage pressure ratio simultaneously without sacrificing either efficiency or stage. The superiority of transient blading employed by NACA was selected from a family of double curvature airfoils. The high Mach blading differed from conventional airfoils in that the leading edge of the blade is thin and the position of zero mean thickness is shifted toward the trailing edge.

Remotely Approach Used

Use of target combination techniques now giving inlet flow velocities up to 140,000 ft./sec. was predicted for targets by F. D. M. Williams, Canada's Ingersoll Ltd. In supersonic combustion, primary atoms will offer less obstruction to the airfoil, stabilizing



Model of Soviet Satellite

Model of Sputnik displayed in Montreal shows location of Russian satellite's four antennas. Sputnik, which weighs 1415 lb., measures 29 in. in diameter, is made of aluminum alloy (AW Cl. 14, p. 27). Sputnik is reported to have reached peak altitude of 150 mi.

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ation will be done in the wake of piston-type liquid boilers and a more recent type of piston will be used, Williams said.

Problems Will Increase

Structural problems of designing combustion for supersonic turbojets will increase as more liquid-boiler jet only will compressor delivery air be over 1000F and make the cooling of the sheet metal parts difficult, but the demands for light overall engine weight will do less, being already evidenced in General Electric's demand that the engine envelope be a continuous monocoque structure.

This will make it impossible to remove the core assemblies of present combustor sections when the core can often be removed from the engine in a few minutes. The combustion systems for these advanced engines will have to be able to operate reliably for 15-20 hr right at the outset of the engine test development program, Williams said. The time limit for the combustion during development will be out of the question and for this and other reasons the combustor section will have to be tackled more seriously in the early phases of a new engine.

Turbine Work

Conventional turbine design truly aspect, according to Roberts and Pickett at NACA, much as where possible is efficient under the high-work conditions required for supersonic turbojets.

However, these issues can be made easier by careful attention to the aerodynamic loading on the turbine blade and the turbine can be "tuned" to even higher outputs without efficiency drop.

NACA has redesigned turbine blades to avoid the usual extreme velocity peak near the suction surface when the blade is being over-loaded. They have found that with new velocity distribution they have been able to design turbine assemblies suitable for driving turbine compressors.

Focke-Wulf Flight Tests License-Built P-149

Focke-Wulf, Bremen, is carrying out test flights of its first P-149 built under license.

German Defense Ministry has ordered a total of 198 of this type from Focke-Wulf to be delivered within the next four years. Price per plane is between \$25,000 and \$28,000.

P-149 is the first of three foreign planes being built under license for the German Air Force to reach completion. The others are the Northrop and the T-109.

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BOHANAN, *still*

first in force ejection



Members of the BOHANAN force ejection team are shown studying a component of a new BOHANAN force ejection system.



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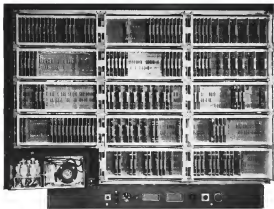
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The Role of PRODUCT ENGINEERING in Systems Work

It has become characteristic of modern weapon systems that they are required to operate under severe environmental conditions, as well as to meet increased weight and space limitations. Moreover, the complexity of many of these systems poses additional difficult reliability problems, while at the same time the increasingly critical consequences that depend on the proper functioning of the typical system logically call for a higher degree of reliability than previously achieved. The same is true of current electronic systems for industrial applications, such as the Ramo-Wooldridge digital control computers, some of whose design features are shown below.

Meeting all of these requirements is no less part of the responsibility of product engineering. Generally speak-

ing, product engineering starts with a system or sub-system at the breadboard stage and implements it into the final product, which in addition to meeting all of the requirements previously stated, must be practical to manufacture and to maintain. Such practical production requires the development of rigorous mechanical design features, a thorough knowledge of design and component reliability, and a broad familiarity with materials and manufacturing processes.

At Ramo-Wooldridge, the product engineer is an essential member of the research and development team which has the full responsibility for creating new systems, from the initial theoretical studies on into the manufacturing stage. Engineers experienced in product engineering are needed to explore the variety of openings which exist at Ramo-Wooldridge in such fields as airborne electronic and control systems, communications and navigation systems, digital computers and control systems, and electronic instrumentation and test equipment.

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work still passing before the practical device is achieved.

These mechanical suppressors are designed to absorb the two conditions in the high velocity exhaust of a jet engine which are the primary causes of its noise. First are the turbulent eddies which are created as the high speed exhaust gases with the low speed surrounding air. These eddies produce fluctuating pressures which induce sound waves.

The second major source of noise is the shock at the edge of the jet blast which results from the steady compression of the exhaust velocity. The shock waves greatly magnify the acoustic output of the turbulent eddies in the jet blast.

Suppressor Method

Mechanical suppressors all attempt to reduce the intensity of these two noise sources by:

- Increasing downstream mixing of the jet to attenuate the strength of the eddies.
- Increasing contact area of the jet blast with the outside air to reduce velocity shock.

Many noise designs have been studied. One is the "cigar pipe" type which passes the engine exhaust through a number of small pipes. As other noise uses deeply folded conical baffles or corrugations to spread the exhaust. Pinhole slots have also been tried on occasion.

All of these types can produce the required jet noise reduction at 15 decibels by being a four jet bypassing passing directly overboard at 180 ft with full power to the static level at a plane with four piston engines under the same conditions.

They are all fixed with the great major disadvantage, however, that weight and loss, pressure on the engine and slow the exhaust velocity causing a thrust loss.

Ejector Reduces Noise

The best, pressure and thrust loss can be eliminated while achieving the required noise reduction by introducing a compressed source with an ejector, according to the NACA. The ejector is a form of jet pump. High velocity air from exhaust air passing through the ejector pulls low speed secondary air around the jet blast. This reduces pressure in the jet stream and the jet velocity above gradient, removing it.

A more gradual deceleration is achieved previously, thus preventing and a long deceleration farther to decrease its weight and the drag of the system.

Another basic approach to the noise problem is a change in turbojet design so that engine exhaust velocities could be effectively reduced. Lowered jet velocities would have added benefits because the engine would run cooler,

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This engine is the Ground Portion Engine Analyzer

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As a part of its jet engine hydraulic starting system evaluation program, Vickers Incorporated recently demonstrated the ability of its starter package to start General Motors fighters. Application to ground idle speed of the F37 turbojet engine, installed in a production North American F-100D Super Sabre, was accomplished in times comparable to other known starting systems... using only 50 horsepower, precise meter power.

Consistent brevity of production Vickers aircraft hydraulic components... performance proven on almost all existing U.S. military and commercial aircraft... the Vickers starting system offers substantial savings in weight, size, and cost — both initial and maintenance — over other known means. Available as either a ground mobile unit or an aircraft mounted engine version, the Vickers starter package is capable of dual function. After engine starting, the hydraulic starter motor can serve as an engine-driven pump for aircraft auxiliary power requirements in the airborne version.

For further information regarding Vickers hydraulic starting systems, write for literature to: Vickers SE-91s. Also, your nearest Vickers representative can show you the many system modifications available to meet your specific needs.



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ENGINEERS AND BUILDERS OF GSA HYDRAULIC EQUIPMENT SINCE 1923



EXPERIMENTAL noise suppression is mounted on a test rig at the NACA Lewis Labors. Noise design lowers noise level efficiently but also reduces engine thrust.

With longer life and greater safety

Current transport engines which are based on military designs require high turbine temperatures and exhaust velocities to operate efficiently. Improved design techniques developed since these engines entered production make it possible to build low temperature, low jet velocity engines which are as efficient as modern jet transport powerplants. These engines would set a new standard for noise reduction which is a large step in the right direction.

Quiet vs. Efficiency

Men operating great against low temperature engines is the fact that the improved design techniques could be used to produce a more efficient design with no reduction in noise. The low temperature engine is also slightly larger than its mass counterpart and would likely tend to increase aerodynamic noise and the gross jet velocity.

One current type of turbojet, which is as efficient and as quiet as the low temperature engine, is the turbofan engine. Noise reduction in this power plant is achieved in much the same manner as the non-engine combustion, but except that the mixing of the low energy secondary flow with the high speed jet exhaust takes place within the engine. The air which is diverted around the combustion chamber, is drawn out just at the compressor on the fan, pump energy is mixed with the main jet in the tail pipe. This gives the turbulent jet exhaust a lower velocity and less noise. Velocity is especially reduced in the shear area between the jet and the outside air.

The third method that the NACA is considering for reducing noise is by using the current flight techniques. Chute as page 73 shows the current

climbing procedure for a jet transport and its associated noise. It also shows one of the recommended flight paths resulting from NACA test.

Noise Reduction Technique

The second technique is to take to the jet transport, hold it down until it accelerates to about 100 ft/sec and then begin the climb. This is the best climbing speed and gives the maximum time to climb to altitude.

The alternate procedure, which is safe in its own right, is to begin the climb at a rate of about 100 ft/sec. This climb is maintained at maximum power until an altitude of 1000 ft. is reached. Then the pilot throttles back to 10% power and brings the nose down to the point that jet exhaust line is constant 150 ft/sec. As shown on the chart, this procedure makes it possible to reduce the sound on the ground by 25 decibels at a point 35 mi. from take off.

It is impossible to make any loud jet test noise short how such climbing techniques will reduce noise in one instance. Low temperature engines are much for this, but it is probable that each separate aspect can reduce its own take off noise to greatly reduce the noise in neighboring populated areas.

There is the further possibility of combining all three of these general approaches to the noise problem to achieve a safe, economical solution. Cost, thrust losses and weight are all factors of the greatest importance when considering devices and procedures to be used by commercial airlines. While effective noise reduction methods may be presently available, their more advanced development before they will be acceptable to the airlines.

PUMP PRIMERS

by
Arthur A. Nichols

Low weight, high performance and universal adaptability in space and geometry of housing structure make Gerstor pumps ideal for auxiliary tube and storage service.

Engineers concerned with drive, auxiliary power location, pipe, hose and various accessories design problems involving pressure information have found Gerstor type pumps extremely useful in their attempts to build weight down and achieve maximum compatibility with high storage reliability.

Several Gerstor firms and their gas suppliers, for example, are using our pumps because they can be so easily adapted to basic design variations of importance in aircraft drive. The Gerstor pump is a positive displacement type, full range of pre-engineered amount of fluid in closed position to speed. It is a form of internal gear pump — has only two moving parts. It is lightweight, versatile, provides exceptional performance and has low weight over a long service life. It is balanced and extremely quiet in operation.

Under commercial gear pumps, the Gerstor pump is a single shaft. Both elements are substantially concentric to a common axis in the main drive shaft. Full-light engagement without the mass structural intensity is a major advantage in the design of pump and pump assembly. Further, Gerstor elements can be stacked along a single shaft and mounted on a single AN pin to perform multiple pump functions.

For example, four of the 1/2 inch components allows pump configuration to be adapted to the gas line.



Fig. 2: Gerstor pump.

geometry. It can be "cuboid" in a pump which frequently may be part of the pump housing, 160-70.

Valveless design brings absence of mechanical trouble and wear problems inherent in valve construction.

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maneuvering facilities are available to help you select the right pump to meet your specifications. Your inquiry is invited.

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ARMED reconnaissance helicopter able to fly 275 in. inches at target. Helicopters then drop quickly behind covering trees.

Army Evaluates Armed Helicopter Units

Ft. Rucker, Ala.—Experimental exercises with armed helicopters here at the Army Aviation Center will be resumed soon to establish tactical doctrine and equipment requirements for operational flying units.

These proposed helicopter units will be self-contained and able to support themselves for three or four days in

the field with their own maintenance, supply and evacuation of battle casualties.

Three functions will be to provide:

- Close reconnaissance over wide areas separating enemy units on an attack battlefield.
- A means of supply, inserting strong reinforcements against enemy troops.

concentrations, supply and maintenance groups that reconnaissance shows to be forming.

To accomplish these missions, flying cavalry units will first reconnaissance closely equipped with small two-man helicopters troop carrier groups with much larger equipment, weapon systems of large helicopters with their whole payload devoted to resupply and evacuation groups of large helicopters.

Patrol Function

Initial tactical procedure of a flying cavalry unit will be to keep reconnaissance groups operating in constant patrols over its assigned sector. These reconnaissance groups would carry four single elements of two helicopters to avoid elements functioning together. They would be able to cover more territory more thoroughly in a single morning. Their individual circles could be several days (depending on the terrain).

Enemy concentrations too small to warrant as strong or full-scale airborne attack and too distant for engagement by motorized troops would be attacked by the flying cavalry. Troop elements would move in a tactical mode to a line of departure where they would wait the weapon helicopter. Weapon sections would then provide the troops access to a landing area close to the enemy concentration.

Area situation fire with machine and machine guns by the weapon section would keep the enemy down and suppress its fire while crews discharged attacks and withdrew. Helicopters of the weapon and reconnaissance sections would then be available to deliver supplies for rescue or target that the disoriented enemy subjected.

Limited to Area Fire

At the moment, only area fire is possible from helicopters, but as their abilities increase it is believed that they will be effective against point targets such as tanks.

Helicopters are able to take advantage of terrain and cover. In wooded and greatly rolling country of the type surrounding Ft. Rucker, large groups of helicopters can move rapidly with little possibility of hostile observation from the ground except from very high vantage points. They fly down stream both, water roads, etc., above a few feet off the ground or above the trees. They attack on scattered targets in sudden and devastating. A small number of armed helicopters can also rate a large area with effective fire for several minutes.

The helicopter is, at times, valuable to maintain a major fire line on the ground. But this will probably only be effective in open flat country with little cover, or if the helicopter is at point blank range. This will probably lead to a withdrawal covering possible routes of helicopter approach to stop firing makes patch and attack groups before they reach their objectives.

Sensing Role

Function of the cavalry scout has at times been to locate the enemy, and the scout results in during major fire. The scout is the small helicopter will probably not be any better or as accurate as his mounted and mounted predecessors. The helicopter will give him a maneuverable and rapid vehicle for his work, as has been demonstrated at Ft. Rucker.

All helicopters in flying cavalry units will have some type of armament for their own defense and for ground attack. The reconnaissance unit will have machine gun and/or rocket installation. Troop carrier will have detachable machine guns which can be fired in flight and then removed for ground use. They will also have port holes so that reinforcements in the cockpit will be able to assist in covering the ground fire that might be encountered. Rescue and evacuation craft will have similar capabilities.

Production is already being made that another element will have to be added to the Army cavalry units. This would be an anti-helicopter section with the specific task of protecting



VICTORY: AH-1G weapon helicopter fires salvo of 3.5 in. aerial rockets. Complete payload of each weapon ship is devoted to machine and machine gun armament.



APPROACH: is made in Sikorsky AH-1G weapon helicopter (shown) before attack (below). A fire of three air strikes a target with confidence fire for several minutes.



ARMED AH-1G reconnaissance helicopter armed with fast 36 cal. machine guns approaches a target at high speed under cover of a stream bed.



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either crash in the water and disintegrated
voluntarily from attack by hostile heli-
copters. It is generally believed that the
only flying machine which will be effec-
tive against a helicopter will be another
helicopter.

Gen. Howe's Description

Major Gen. Howes II Howes de-
scribed the army's study of the feasi-
bility of aerial assaults as follows:

In June 1956, when Brig. Gen. Carl
J. Blanton was commanding a small
group of volunteer pilots and related
aircraft were assembled at the Army
Aviation School and aerial security tests
were begun, using reconnaissance heli-
copters as test beds.

Four functional categories of aircraft
were considered:

- Reconnaissance vehicle (H-33, H-33
class)
- Signal carriers (H-21, H-34 class)
- Assault vehicle (all classes)

Following weapons were studied for
possible application:

- Aerial machine guns—30 and .50 cal
- Various food for aerial rockets
- Various folding air-to-air rockets
- Rocketless rifles
- Ordnance and chemical bombs

Test program was divided into three
phases:

- Feasibility studies and experiments
- Tactical employment tests of platform
and company-sized units of aerial heli-
copters
- Organizational studies based on first
two phases

First phase is, and will be, a continu-
ing series of experiments at different
altitudes are tested for the roles indi-
cated.

Some Capabilities Known

Known capabilities are:

- Reconnaissance helicopter—As one or
more machines just were believed to be
required, tests were made to determine
a minimum machine gun capability of
the light helicopter.

This was determined to be two
AN M2 .30 cal. aerial machine guns
(500 rd. per gun per min.) or one AN
M2 .30 cal. machine gun (1,250 rd.
per gun per min.). Tests for 50 mm.
aerial rockets were successfully test
fired from a light helicopter. The feasi-
bility was 15 in. rocket rockets. All
weapons were fired electrically and
adjusted to six seconds optical sighting
light.

- Signal carrier (H-21, H-34)—Support
for capabilities have been determined
that the day can fire two as many food
aerial machine guns forward. It can
carry eight or more food in 50 mm.
rockets forward. The H-33 can handle
a four .30 cal. machine gun turret fire
and of the same wheel. Machine gun
(30 cal.) can be fired from side doors

MEMO TO *Designers of Aircraft & Missiles*

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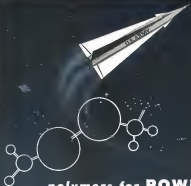
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• **Worst case.** Baffles can be fired from each port.

• **Weapon ship.** (31.09, 1025).—These ships can fire their automatic stage lift capacity in the form of solid rockets. Number of rockets depends upon weight and configuration of individual rocket and its launcher. This is about eight in the 5-in. class and up to 160 or more rockets in the 1.75-in. class.

• **Antismoke vehicle.** (41.09, 1025).—This study is still being conducted and results are not ready for release.

Some basic characteristics of armed helicopters have been observed. These are indicated by type.

• **Reconnaissance.** This is a light ship and therefore needs about twice the fuel as a normal ship. Ship can be refueled rapidly by tanker aircrafts so range factors are not too critical. Direction and depression of weapons and sighting system is essential to compensate for the vertical angle along pitch axis with different load conditions and it speeds between the low and Vmax. It has a hard-to-rotate wheel which results in a wobble or rocking case of about 7.5 in. (including pilot body response). Pitched in level by ship's own weight. Sighting from a boat is better than a ship's own weight.

• **Signal carrier.** This is a large, heavy ship and appears to offer much a more stable firing platform than the reconnaissance helicopter. As its tactical function is to observe and report, it is not too critical. It is a platform for observation and detection from a distance when in formation, both elevation and its rate of rotation is indicated. Tandem rotor configuration appears to offer more stability along the pitch axis. Sighting straight ahead is simple. Detection from a distance is a problem. Detection from a distance is a problem. Detection from a distance is a problem.

• **Weapon ship.**—Stability of the orbit class helicopter appears to be between the signal ship and the reconnaissance ship. Direction and depression of weapons appears to be critical. Direction of fire and firing weapons appears to be difficult but can be controlled under the ship is to be fired from right to left. Target tracking accuracy is not too critical.

• **Antismoke ship.**—All lessons learned from other tests are being applied to this study as experiments continue.

Improvements Anticipated

Improved engineering designs of proposed helicopters will greatly increase the accuracy and speed capabilities of the helicopter as well as provide a much more rugged and dependable structure.

The armed helicopter, if the worst case is disposed of the worst case, represents an effective means of delivering concentrated firepower for power or short range. It is not intended that the weapon replace the lighter bomber or the attack vehicle or tank. It is believed, however, that it does have the capability of effectively filling the gap between the tank troops and the bomber and the tank will provide the support.

Extensive testing is not to be conducted to determine the full extent of the helicopter's capability as a firing platform. Vulnerability factors must be established and its dependability must be established. It is apparent that the helicopter has a great potential in the highly mobile, tactical situation as it is used in any future conflict.

Evaluation of this aircraft in future field exercises will be beneficial in determining the full extent of this potential.



15 Years Makes a Difference

Sikorsky HO4S (previously) emerged 15 years ago as the world's first production helicopter. Today it is a 5-36, light Sikorsky aircraft in production.



M1336 (11) is a 30" x 30" x 30" working volume. Ready to 1000" in 20" working volume. Precision under 0.001 in 2 minutes of time. Image is direct.

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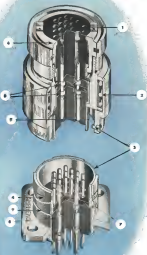
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FIGURE Q-14 shows a transponder between two 300 ft. towers (one in background) in radar target. PARAME transponder is in post.

System Measures Near-Miss Distance

Missile near-miss distances are being evaluated for the Air Force in Rome Air Development Co. with its electronic Parame test data.

Rome is using two methods to measure the distance by which a missile misses the target.

- Passive Active Range/Altitude Measuring (PARAME) system
- Wide angle less current measured in target's wake

Flight tests are scheduled in the near future at Air Force Missile Development Center, Holloman AFB, N. M.

Meanwhile, a series of tests have already been run at Rosendown Wash facility, Naval Ordnance Test Station, China Lake, Calif., where the F-106 Q-1A drone was suspended between

towers at a target for longer in high velocity rocket rockets (HVAR). These tests will assist in calibrating results obtained in both the PARAME and angle sensors scoring systems with corresponding distances obtained from various measurements of known accuracy, using range finding for correlation.

PARAME Systems Utilized

Ralph M. Powers Co., Pasadena, Calif., is supplying five of the PARAME systems to Rome. One system already has been used in the Rosendown Wash initial tests, the remaining four PARAME systems will be used in Holloman tests.

PARAME criteria includes target transponder is located in F-106, nar-

row transponder, and measuring and recording transponder with direct distance read-out of missile-target distance versus time.

For Rosendown Wash tests, Powers modified 10 HVAR rocket warheads and installed antennas, wiring and a measuring plate for the missile transponder.

Transponders in the F-106 and rocket each transmit a signal pulse at a different frequency which is received by and triggers the other transponder thus forming a "ping-pong" loop.

Range frequency is reduced by a delta. Such was the F-106 test power, with frequency shift corresponding to separation of target and missile antennas.

Range frequency is measured in



LAUNCH tower has tall launch 70 ft. long (left), rocket (right) has equipment for missile transponder in place of rocket.



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Yet, what we have, what we have done, is nothing to what America in its unbounded reserve capacity can do. As the speed of progress accelerates, we will take it in stride without sacrificing human needs.

The future, like the present, will be in America's control, which is a very fortunate thing for a free world. It is our job, and the job of every nation to keep it that way.

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AVIONICS

Plant Choice Keyed to Vibration Level

By Philip J. Klass

Clewiston, Fla.—Now 544 million facility for developing and producing aerial guidance systems and components, called "world's most sophisticated plant," has been opened here by Minneapolis-Honeywell on Florida's west coast, near St. Petersburg.

One corner of the 50,000 sq. ft. facility is located at 27° 57' 25.3" N. Lat. and 81° 43' 15.0" Long. which defines its position to within 10 ft.—a necessity for precision alignment by celestial means of aerial platforms under test.

One of the major reasons for selecting the Clewiston location over 20 other sites was its relative isolation from natural and man-made vibrations—a requirement for testing gyroscopes that have drift rates of the order of 0.001 deg. per hour. Honeywell equipment measured the vibrations caused by winds from the Gulf of Mexico, 10 mi. away. They also measured earth-tidal vibrations—the periodic shifts in earth's crust caused by sun and moon gravitational pull.

Soil Samples

Soil samples were taken down to depths of 60 ft. to test compressive characteristics of sub-soil because sub-soilward shifts in plant floor level can introduce appreciable errors in inertial component tests.

Honeywell says that certified vibrations in its gym assembly and test area is less than 32 millioctaves of sq. wph, and as low as four micro-inches on special test pedestals. Horizontal vibration is only one micro-inch.

To achieve this degree of isolation the company went to great lengths. The plant is built on pre-stressed concrete pilings, 10-15 ft. deep. To measure the effects of moisture, the plant floor is constructed 24 in. above ground level and the building is surrounded by a large moat, extending three feet below normal ground level. Asphalt spouts run from building to the moat to carry off rain water and the moat is continuously pumped dry.

Gyroscopes are built on 18-in. slabs of concrete and are isolated from air standard of the building. Gyros and shakedown platforms are tested on 16-ft. concrete pedestals to isolate them further from vibrations. All heavy, vibrating machines, such as air conditioning, compressors, and special power generators are mounted on springs and rubber pads and located in a pressure-sealed



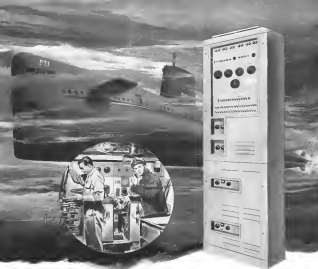
MINNEAPOLIS-HONEYWELL's new Florida facility will develop and build aerial systems and components.



FLIGHTS gyros are fitted with vacuum seals in vacuum chamber to prevent contamination.



OPTICAL-colored means are used to align aerial platforms before testing.



To voice the world's newest submarines

The skipper and battle-announcing needs of a submarine pose problems that just "standard" equipment can't meet.

Exceptional ruggedness is required, both to withstand shock and to resist heat, humidity, and salt moisture.

Power must be adequate, yet compressed into the smallest possible space.

Dependability is relative: in such factors as cruise distances never before attempted by underwater craft.

An example of products meeting such prob-

lems is found in the announcing equipment aboard the atomic-powered *Nautilus* and *Seawolf*, built by our submarine division, Electric Boat, and "voiced" by Stromberg-Carlson. Here standard components were re-designed to the special conditions involved. On the *Nautilus*, in fact, our equipment has logged more than 60,000 nautical miles without difficulty of any sort.

Similar equipment also serve the land and air arms of our country's military forces and give evidence of equal dependability under the special conditions for which they were designed.

STROMBERG-CARLSON

A DIVISION OF GENERAL DYNAMICS CORPORATION

Head Office and Factory at Rochdale, N. Y. • World Sales at New York and Los Angeles, Calif.



Cryogenic Gyroscope

Massachusetts Institute of Technology, the second other company, is investigating feasibility of building gyroscopes that employ spinning electrons as non-shockable non-temperature sensitive of conventional spinning gyros, according to a company official. Progress is in the research stage.

Among the plant's Peabody steel gyro does are reduced in size to provide further vibration damping.

Current Programs

Boeing plant is presently an stage meeting and pilot production facility which can turn out about 60 inertial systems per year. Plans are under way for a 100,000 sq ft manufacturing facility addition when business level requires, according to Milton P. Folden, vice president and general manager of the site, operations.

Current program at the new plant total about \$5 million, including development of "a new type of inertial guidance system," for Air Force's Wright Air Development Center under a \$18 million contract. Boeingville also is building a three gyro (gyrocompass) stabilized platform and associated attitude programming for use in the Titan and Thor ballistic missiles. These reportedly are similar to the ones the company developed for Project Vanguard earth satellite program.

Boeingville also is developing digital computer links with computer funds for use in inertial systems. Digital computers are expected to reduce size,

weight and improve computational accuracy over analog computers presently used by Boeingville.

Current employment here at around 150 of whom about 200 are professional engineers. Total employment is expected to reach 650 by end of the year with an annual payroll of about \$15 million.

Boeingville reports that it has made significant gains in both the accuracy and reliability of integrating (IHG) gyros which form the cornerstone of the firm's inertial systems work. Company officials say that the new facility is producing IHG gyros with drift rates in the order of 0.001 deg per hour.

This is roughly 100 times better than the early IHG gyros, and approximates 1,000 times the accuracy of early potrogy gyros.

Boeingville's Massachusetts facility will continue to make low-cost IHG gyros with moderate drift rates for use in low altitude missiles, while inertial quality gyros will be developed and built here in Florida.

Another indication of gyro progress was the report of significant reduction in the number of parts used in IHG gyros. Boeingville first (from market quality) IHG-5 gyros was constructed from 415 individual parts, according to John W. Anderson, manager of engineering here. In a subsequent IHG-6 model, the number of parts was cut to only 125. One of the latest inertial-quality IHG-6 now under design has only 90 parts.

Anderson also reported that company's new M-10 (inertial output rate gyro), originally expected to have a drift rate of 0.5 deg./hour is exhibiting drift rates of only 0.1 deg./hour, equal to the accuracy of the much larger IHG-6. New M-10 gyro is used in Army's Sergeant missile, Anderson said.

But those gains in gyro accuracy have reached the peak, Anderson said, where gyro designers must now concentrate with the oscillatory nature and internal damping of oscillators of the systems from which gyros are fabricated.

Effect of Errors

Critical effect of small gyro inaccuracies and degraded rates in inertial navigation accuracy of an inertial system was pointed out by George Fowler, head of systems engineering here. If a Schuler-tuned inertial system used as a Mach 1 missile is to have an accuracy of 100 ft at a 1000 ft range, the inertial system after one hour's operation, individual elements of the system must meet the following requirements:

- Gyro drift rate must be less than 0.005 deg./hr.
- Accelerometer error is increasing



OptiTherm® Infrared Radiation Sources

Temperature controlled black bodies

Infared sources are typical of the integrated line of OptiTherm components available from Barnes Engineering. OptiTherm Sources are accurately measured as precise black body standards for testing and calibrating infrared detection systems and instruments. Most of the calibration sources for the SILEX INDEF program are made by Barnes Engineering.

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Advances in radiation and accurate temperature measurement are made in developments that originated with the Infared Division at Barnes Engineering. They are equipped and skilled to develop precise infared systems.

If you are thinking of using infared, write for a complete information on the integrated line of Barnes OptiTherm infared components, sources, detectors and components.



BARNES ENGINEERING COMPANY
Stamford, Connecticut

For more on the meaning of **TECHNOLOGY**, this publication, devoted to developments in infared detection, will be sent on request.



Compact Memory

High-speed, rugged, built-in on-chip memory is a key element in the new high-density data storage on North American Attolite Division's portable general purpose digital computer (RSC-200). Memory with less than 100,000 words is the field without maintenance, company reports.



THE NEW GENISCO

ANGULAR OSCILLATING TABLE

Generates a precise sinusoidal rotation oscillates at within 0.1% of excursions up to $\pm 90^\circ$, $\pm 15^\circ$ up to $\pm 100^\circ$, and $\pm 5^\circ$ up to $\pm 180^\circ$.

This recent Genisco purchase offers a unique control mechanism to generate an angular oscillation which closely corresponds to a theoretical sinusoidal waveform. A precision sine-wave oscillator mounted to the oscillating table can be used to bring a test instrument output signal and the oscillating table output signal into coincidence for direct reading of phase lag angle.

The extreme accuracy of the Model E350 Oscillating Table makes it particularly suited for evaluating the frequency and response characteristics of angular accelerometers and rate gyros. The Model E350 can also be used for calibrating peak angular velocity and peak acceleration to the accuracy of the known regular frequency and frequency within its range. The excitation can double as an accurate angular shaker table.

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Drive specifications
Applied torques including acceleration
from 0.01 to $\pm 10^3$
Maximum torque continuously up to 100 ft. lbs. or 200 ft. lbs. in a range of 1 ft. lbs. to 100 ft. lbs. in 10 ft. lbs. steps
Power input
Applied torques—within 10 percent of max.
Power input 1000 watts—4000 ft. lbs. with
oscillator within a 1 ft. lbs. drive torque
Signal frequency 100 to 100,000 cps in
either direction or 1000 cps in 100 cps steps
Accuracy to 0.000001 sec. rms
Oscillator band pass
Voltage fluctuation $\pm 0.001\%$ rms at any frequency
Control dimensions 100" x 100" x 100" (approx.)
Weight 1000 lbs.
Approx. weight 100 lbs.

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acceleration must be less than 0.00015 G.

This is the equivalent of an acceleration so small that it would require an automobile accelerating at that rate from a dead stop a total of 73 hours to reach 30 mph, Rader said.

•Angular alignment error of platform at start of motion must be less than 0.04 deg. This is equivalent to one inch displacement in 100 ft.

•Final integrator error (drift) must be less than 0.04%.

Clearances

Assembly of gears and other metal components is carried out in familiar clean-fee rooms, with an emphasis, as usual, from the state of Florida, which itself provides a relatively dust-free environment. Folders say the means of filtering and electrostatic precipitation, the dust count in the gear areas is maintained at less than 11,000 particles (one micron or larger) per cubic foot. The count often is down to 5,000 per cubic foot, Folders say.

Expansions, Changes In Avionics Industry

Fairchild Sensi-Composites Corp., Palo Alto, Calif., is one of new firms engaged by Fairchild Camera & Instrument Corp. as one of several avionics recently acquired at Rockwell International's Mojave Research Laboratory.

New company, which will develop and produce semiconductor devices, is headed by H. E. Hild, vice president of Fairchild Controls Corp. Dr. Robert Navin heads new company's research group.

Other, recently announced expansions, changes and mergers in the avionics field include:

•Yonah Aircraft Corp., Gilched, Tex., has completed \$50,000 contract research laboratory for testing performance of electronic systems.

•Boon, Allen Applied Research, Inc., a new name at the former Applied Research Inc., Corporate 1 new address is 4100 Green Bay Road, Knoxville, Ill.

•General Electric's Computer Dept., Phoenix, Ariz., has opened new Computer Application Laboratory, staffed by more than 70 specialists, to handle business, scientific, engineering problems for its many customers. Dr. Herbert R. J. Gresh heads new laboratory.

•Sperry Gyroscopic Co. has opened new business office in Dayton, in Mountain Ridge, which will be added to various offices of company's Avionics Equipment, Air Armament, Microwave

Edgewater rings



Uniform, dependable, accurately made Edgewater Rings are furnished in a wide variety of cross-section shapes, and in diameters from 5 to 145 inches. They meet the most critical specifications and standards of quality.

Representative applications include bearing rings, jet engine parts, parts for missiles and rockets, gears, grinding rings.

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World's First Unmanned 'Copter

The successful maiden flight of Kaman's phoebus helicopter has added a new concept to military strategy. Flies entirely by remote control, the variety of missions possible with these ships is almost limitless. Using the Kaman robot as a flying TV or motion picture camera, complete battle-field surveillance and target marking are achievable without hazard to personnel. Also possible is the entry of the robot helicopter into contaminated or hazardous areas.

The control station is portable and can be operated from the ground or in an aircraft. Mission equipment such as cameras, weapons, target markers and detectors can be installed at the control station.

Kaman is proud of this forward step which has been taken in behalf of our National Defense effort.

KAMAN

THE KAMAN AIRCRAFT CORPORATION
Bristol, Connecticut



20 Amps At 200C

Miniature silicon rectifier, rated 20 amps at 200C with peak one-cycle surge rating of 400 amps, maximum bridge current at 9 ma., are now in production at General Electric's Semiconductor Products Dept., Clarks, N. Y. New outline comes in two types: IN1004, IN1005, IN1004 and IN1005, with peak forward voltage ratings of 90, 100, 200 and 400 volts, respectively.

Electronics and Electronic Tube Division

•Gulton Industries, Inc., Metuchen, N. J., has acquired Transic Electric Corp. of Canada, Ltd., Cambridge, Ontario, through stock exchange. New acquisition will produce electronic instruments and components of great variety.

•Laboratory For Electronics, Boston, has formed new Computer Products Division to develop and market data processing devices. New division was formed from personnel previously engaged in developing data processing systems for bank use after company decided to withdraw from the complex data processing systems field.



•Semiconductor Device Switch-Relay (SWSR) Laboratory has developed, but not yet officially named, new semiconductor equivalent of the basic switching tube which makes it possible to construct 70 stage switching counter as a device about 1 in. long. Load (output) consists of 10 pins may be possible from each stage.

•Micro-Miniature Magnets—Permanent magnets as small as diameter of a human hair have been made from Canada (60% copper, 30% nickel and 20% iron) at National Bureau of Standards. Material has several interesting properties. It can be cold drawn instead of requiring cutting or annealing into desired shape. Canada can be cold worked to peak where its magnetic properties are adversely affected but metal properties can be restored by simple heat treatment, Bureau of Standards says.

•Major Gain in Telephony—Which for Bell Laboratories, Inc., to reveal a new

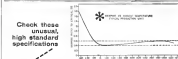
PA/TM telephony receiver design technique which reportedly will provide at least a 10 db gain over existing systems without modification of telephone transmission.

•Transistor Sales Continue Climbs—Semiconductor manufacturers add 15.6 million transistors during first eight months of 1957, more than double the 6.8 million sold in the same period a year ago. Dollar volume was \$42 million compared to \$19.7 million last year. Figures were released by Electronic Industries Assn., Security Radio Electronic Television Manufacturers Assn. (RETMA).

•New Lightbright No./Gase Package—Last year's new light bright night-vision integrated optical communication package for business security illuminator, weighing about 21 lb., will include VHF receiver, transmitter and permanent navigation provisions. More complete package, weighing about 57 lb., will include the ranging plus marker beacon, glide slope receiver and automatic direction finder.

•Measurements, Anytime—The 1958 National Symposium on Measurements Theory & Techniques has been scheduled for May 7-7 at Stanford University. Prospective authors should submit 100

The SUBMINIATURE PRECISION RATE GYRO With Constant Damping Over A Wide Temperature Range*



1. Constant damping (8.5 to 1.5 sec) over -50° F to +100° F
2. Miniature size (1.00" dia x 2.0" long)
3. Outstanding reliability (exceeds requirements of MIL-R-8830A spec)
4. High resolution
5. Extremely high natural frequencies (up to 80 cps for 1 pulse/sec) lower if desired
6. Variety of order characteristics available (0.1 to 100 cps; 0.1 to 100 cps; 0.1 to 100 cps)
7. Wide variety of mounting ranges (from 0.05 in. to 2.0 in. dia; 0.1 to 1.0 in. dia)
8. Light weight; 0.7 oz.

DETROIT CONTROLS
DIVISION OF AMERICAN-Standard
100 Morse Street, Norwood, Massachusetts



speed about 400 and 500 words per minute before Jan. 15 to 30. On Riva Terrace, 901 California Ave., Palo Alto, Calif.

• **Information With French Aircraft**—France now talks around only to the United States in the manufacture of electronic data processing machines, according to publication *France Actualité*. France exports more than \$3 billion annually, publication reports.

• **Signal on Dotted Line—Scot**—closes manufacturing report following new business.

• **Cable Corp.**, San Diego, has received \$1.1 million Air Force contract order for production and installation of its Saco system for missile tracking and imaging.

• **Technical Research Corp.**, New York City, reports a \$450,000 Signal Corp. contract for study and design of an atomic clock, which will be automatically engaged in operation to a radio and without handling clock.

• **Electronic Communications, Inc.**, (formerly Air Associates) St. Petersburg, Fla., has received \$12 million contract from Hughes Aircraft for airborne communications and data link equipment to be used in Hughes' fire control system for the F-102 and F-106.

• **Togo Manufacturing Co.**, Los Angeles, has received \$2.6 million contract from Cal. Aeronautics Administration for 65 emergency transmitters.

• **Private VGRs—Civil Aeronautics** Adm. administration has established requirements for maintenance, performance and maintenance of privately owned (non-federal) very high frequency omnidirectional radio navigators (VGRs) in CAA Technical Standard Order N27. The piece of N27 is to obtain standardization of VGRs such as are operated by state aviation organizations with those installed, operated and maintained by the CAA.

• **British to South Africa—Scot**—new Viscon Vaconair transport to South Africa Airways will be equipped with automatic weather radar system to be delivered by British Aviation before the end of the year.

• **Army Missile Components—Army** is reportedly confident that General Electric's Missile and Guidance Systems Department has been working on strong and strong systems for five Army missiles—Houou Joke, Little John, Corporal and Lance. Surface-to-surface missile and the Nike-Hercules surface-to-air missile.



Known tubes for cockpit use, one using newly developed transparent phosphor (above) and the other conventional transparent phosphor (below) are key elements in new Army-Navy cockpit display undergoing flight tests in T2V-1 (AFW Oct. 21, p. 34).

Flat, Transparent Cathode Ray Tube Tested in Army-Navy Cockpit Display



Transparent flat tube permits pilot to see through it for cockpit flight. Development of flat tube was first awarded by Aeronautics Week press photo (Sept. 26, 1956, p. 18).



Standard pattern of cockpit flight is presented on transparent flat tube mounted behind windshield of T2V-1. Lightweight digital computer, developed by John Johnson, and an analog generator, developed by DeLmont, provide inputs which create present presentation as flat tube intended to simulate what pilot would see under control (VGR) light conditions. In alternate version...



Conventional instrument panel, in one cockpit of the T2V-1, along lines of conventional cockpit instruments, points up greatly reduced complexity of proposed new Army-Navy display. New instrumentation has been demonstrated to nation's leaders.



Flat tubes will be used both for control and instrumented situation displays as shown in mock-up. Small digital control 'system' is operated by right hand, new type throttle control is operated by left hand. Douglas Aircraft Co., joint contractor on the program, designed the layout for future cockpit applications. Simplicity of cockpit instrumentation is a needed contrast to...



Central control computer (above) and magnetic storage device (below) will perform all required computations of flight and navigation data, eliminating analog type computers now employed. Models shown are interim components to be replaced by improved models.

Sillwhite Flexible Shafts Make Operations Easier!



The manufacturer of this test control for a radio TV set uses a standard S.S. WHITE FLEXIBLE SHAFTS to cope with a 50" run. The shaft needs no adjustment... can be quickly and easily installed. Costs are lowest... maintenance is simplified... assembly operations are easier, faster.

You can often reduce a complex system of gears, universals and other parts to One Flexible Shaft! Flexible shafts also make better design possible... allowing new freedom in locating connected members to meet space and facilitate operation and servicing.

For many years, these versatile shafts have been making industrial operations easier. They are tough and rugged... yet have the flexibility you need for delicate adjustments. Design engineers and manufacturers discover new uses for S.S. WHITE FLEXIBLE SHAFTS every day. Can your product be improved by a simple... better... less costly way of transmitting power or motion control? Our engineers will be glad to work out a flexible shaft application with you. Just write to:



EXPERIENCE DATA on how to select and apply flexible shafts. Write for Bulletin 304.



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IN FLEXIBLE SHAFTS

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EQUIPMENT

New Turbojet Test Cell Can Be Airlifted

Ontario, Calif.—Completely portable three-unit test cell system has been designed to accommodate turbojet engines up to 15,000 lb-thrust capacity. System was demonstrated successfully in tests with a J79 preprototype in a group of about 25 military representatives from Air Materiel Command, Wright Air Development Center, Oklahoma City Air Materiel Area, Tenth Air Command and Strategic Air Command.

In translation of a run-free test of simulating from week-to-weeking into up of three test cell units, translation of J79 on duty and engine light-logged time was 1 hr. 51 min. for an area and two superunits.

Developed jointly by General Electric Co.'s Production Engineering Dept., Enid, Ok., and company's Aero-Engine Service Shop Ontario, Calif., the new portable field test facility includes:

- Engine dolly,
- Control trailer,
- Fuel trailer.

Designed for Airlifting

Total weight of the three units is less than 15,000 lb. Each is designed to be completely portable by air, and can be moved on land at 25 mph. To meet low-maintenance requirements.

General Electric so far has built only one portable test cell system, which was used in the military demonstration, and is also scheduled for use by General Electric in its own property in an aircraft at Dallas, Tex., as a part of the Air Force Convair B-58 bomber program.

No prearranging has been set for the portable test cell system but it is likely to be in the neighborhood of \$10,000. High degree of commercially available items have been used by General Electric in construction of the test cell system.

70-Day Development

General Electric says that only 70 days elapsed from the time specifications for the test cell were fixed until initial demonstration.

While projected to meet Air Force requirements for a portable test cell, General Electric specially tailored the prototype system for its J79 testbed. But the company says that system can be modified with adaptions and minor changes to handle any jet engine in existence or currently projected, says the dolly's design limitation is 15,000 lb thrust.



PORTABLE test cell system is set up for a check of J79 testbed. Note how test cell dolly is supported by four earth anchors which extend about 5 ft. into soil.



CONTROL trailer has storage area forward, control section aft. Pneum. air and water to jet engine in rear. Operator's window is over main instrument panel.

System also has protected in the commercial market where relatively expensive jet engine test facilities are required, for example, at aviation or aerospace bases in use during transition to permanent test cells for jet transport engine testing.

Anchored to Ground

Reframing mechanism for the engine dolly consists of four earth anchors in segments for anchoring the dolly on a soil base for field testing. Each segment has a 15,000 lb shear test capacity. Two rear segments are connected to the two front segments by steel beams. Front seg-

ments are tied to the rear of the engine test dolly.

Engine dolly which can mechanically rotate in that dolly's chosen run on ground.

Thrust exhaust is translated through dolly's members to the thrust bearing clevises.

Notes regarding with steel parameter a placed on the ground under the feet of the engine inlet to prevent such up of lower earth in other dolly.

Dolly also can be adapted to concrete pads by fastening steel air base frame to anchors.

Minus torque and with which in-

Minda Kay Armstrong

[illegible][illegible]



THREE-POINT testing unit keeps curved panel (above) properly positioned.



GANTTRY uses an angled panel, diverting the panel and driving across rivet material.

Mobile Unit Speeds DC-8 Riveting

New gravity carrier speeding production on Douglas DC-8 jetliner is a totally a large mobile unit in which tools containing riveting equipment travel wheels over the panel. It is triggered into appropriate working position in an operator using an infrared beam.

Known as MonoCripin riveter, principal feature of the machine is that it brings the riveting operation to the work, instead of moving work

to a stationary riveting location. Douglas points out Rivet-bearer longitudinal must work in a channel, as it can rotate, allowing riveting equipment travel wheels over the panel. It is triggered into appropriate working position in an operator using an infrared beam.

Only space necessary is for the length of the part.

Yoke containing the riveting and drive cog takes a only hand positioned over

ripping location. Inadequate riveting area of the panel is automatically monitored 90 deg to the area of riveting until by a sensing unit.

Automatic work starts with bottom yoke containing a pressure foot engaging the work, pivoting a clamp base to separate panel upward against rivet head.

Riveting within lower cylinder, rivet gun, again, rivet against panel, then retracts. This is followed by driving mechanism that removes excess rivet metal to close between. After driver retracts, yoke is hand-positioned to next rivet location and cycle is repeated.

Riveting system now controlled by T. S. Gropin, sales administrator of Douglas Santa Monica Division. Machine is manufactured under license by Mono Mfg. Co., Boulder, 10.

Five of the riveters are in operation at Douglas aircraft's Long Beach Division.

W. Germans Negotiate Powerplant Licenses

Both BMW Turbomotoren (Munich), a subsidiary of Bayerische Motorenwerke (Munich), is negotiating a license agreement for Licensing aircraft engines, another agreement with General Electric Co. for licensing the M1, 3 and M1.6 of the General Aircraft, and a cooperation agreement with Rolls-Royce as part of a development of some turbojet engines which the German Defense Ministry is expected to order in the near future.

Ultrasonic Detector Finds Metal Defects

Ultrasonic equipment capable of detecting flaws in metal plate, hyper wire, forgings, rolled and extruded bars and other shapes of various dimensions and sizes has been unveiled by Republic Aviation Corp.

Inspection consists of an ultrasonic transducer, fixed with a receiver, search coil, pulsing equipment, electronic flow detection equipment and a bridge circuit for external handling.

High frequency pulse waves indicate on an oscilloscope whether there are any defects in the metal being inspected, and the location and extent of any flaw.

Equipment features an alarm system which warns the operator by flashing light or ringing bell when a defect has been located. Electronic machine transmits waves at frequencies ranging from 20K to 25 MC.

Republic says that the equipment

HOW TO SOLVE AIRCRAFT AND COMPONENTS DESIGN PROBLEMS WITH

GE SILICONE IDEAS



Problem: Find a high-temperature silicone idea that can help solve this one.

Solution: Wire made with GE silicone rubber insulation.

Exposed to an 1800°F flame for hours, GE silicone rubber insulation still insulates, forming an ash of silicon dioxide, an excellent non-conductor. No toxic fumes are released, nor will it char and weaken the wiring, as the laboratory experiment on the left shows. Silicone rubber has superior dielectric strength at high temperatures and keeps it for years. It stands up well to oil and fuel solvents, has low water absorption. It is highly flexible down to -75°F.

Check out the specifications for silicone rubber overall and against wire, for it meets better than standard wire, and much less than other high-temperature wires. Technical literature and names of qualified wire and cable manufacturers are available on request.

Problem: Organic rubber parts being because of temperature extremes and cause high loss and tensile strength cannot be modified.

Solution: Replace with SE-555 silicone rubber with tensile and tensile strength comparable to organic rubbers.

SE-555 is a new silicone rubber with tensile and tensile strength double that of ordinary organic rubber. (See comparison typical rubber of left.) It has superior mechanical resistance to oxidant and temperature extremes (from 150°F to 200°F) is required, combined with high wear and tensile strength, usually SE-555. This is the only material available to rubber manufacturers that meets AMS 3580 requirements for tear and tensile strength, elongation, heat resistance, compression set and low temperature flexibility. SE-555 can be fabricated in practically any color, including white.

You can order high strength silicone rubber parts immediately because SE-555 is available from stock for shipment to you. Substitute. The same information and a lot of qualified information, send the coupon below.

Problem: Find a hydraulic fluid that functions over the -30°F to 200°F range needed by Navy aircraft.

Solution: Versylube F-30, General Electric's new silicone fluid, with the best performance over this range of any hydraulic fluid now available.

Over the -30°F to 200°F range, only General Electric's new silicone fluid, Versylube F-30, provides adequate performance at all these areas: thermal stability, high viscosity temperature coefficient, oxidative stability, excellent shock resistance and hydrolytic stability. No other commercially hydrolytic fluid matches the thermal stability of GE Versylube F-30 in 1000°F and for many applications, up to 200°F. Its viscosity is unaffected at temperatures as high as 200°F and comparable to other hydraulic fluids in the moderate range. Versylube F-30 also maintains a more nearly constant viscosity than other hydraulic fluids over the -30°F to 200°F.

The more information about Versylube F-30 and other GE silicone fluids, send the coupon below.

Write for more information . . .

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Send D2718, Silicone Products Dept.

General Electric Company, Watertown, N. Y.

Please send me that name of available information, plus names of specialists, if ☐ silicon seal ☐ but at start ☐ silicone fluid for mechanical applications ☐ I also want data on

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Company _____

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MCDONNELL
Aircraft Corporation

Helicopter Simulator Is Research Tool

By Craig Levin

FL World-Design Helicopters recently has been developed by Bell Aircraft Corp. as part of a long range program to design an ideal helicopter instrument flight system.

Simulator employs a contact analog to simulate contact helicopter flight and will be mounted on a dynamic platform to duplicate actual flight motion.

Base simulator cockpit is now in operation at the Bell plant here.

Bell developed the simulator as part of the Army-Navy Instrument program a contract with Douglas Aircraft Co. under the supervision of Office of Naval Research (ANW Dec. 21, p. 54). Bell is present contractor as a program aimed at development of an optimum helicopter instrument system, and Douglas must a similar program to find wing aircraft.

Psychological Tests

Bell's contact analog could eventually form the basis for an actual instrument flight system, but right now its primary use is as the simulator system. Simulators will be used for psychological tests of various display in determining the optimum display system for people, efficient helicopter operation.

Current simulator version is built around a closed, not real, color equipped with a seat, flight controls and a contact analog display. The display presents two pictures to the pilot—one

represents a view straight ahead and the other a view downward at a 45 deg angle.

These pictures are presented on two 17 in. cathode ray tubes, and the system will be able to use flat tubes where they become available.

The display can indicate pitch, roll, yaw, altitude changes and forward and lateral velocity. The display depicts current flight as terms of a field of squares. The forward view shows this grid pattern descending to a distant horizon, while the downward view is filled with a grid pattern.

Grid Simulates Motion

In flight simulation, the grid pattern moves just as terrain would appear to move in reference to the pilot in actual instrument flight. The squares increase or decrease in size to simulate altitude changes, the horizon moves to indicate roll or pitch. And other features show the pilot how fast he is moving over the simulated terrain and in what direction.

The simulator system is run by an analog computer through a display generator.

A test program is set up in the computer, and signals are sent to the generator. Bell is using an electro-mechanical generator now, but an electronic generator being developed by DeMott Laboratories will replace it around the time of the year, and the new generator will give the system smoother, more precise display.

Two television cameras pick up the grid pattern from the generator and display it on the two cathode ray tubes in the simulator cockpit. In the future, Bell may shift to a random dot pattern to replace the grid now in use.

The pilot closes the loop in the system when he moves the simulator controls in response to the display. These movements go to computers and also to the computer whose they become signals for adjustment of the display.

Each next year, a dynamic platform developed by Princeton Institute will be added to the system. It will be driven by hydraulic sensors and will add motion to the simulation process.

When the DeMott generator is available, Bell will be able to fly the contact analog system as an HIL-7 helicopter. An HIL-7 cockpit will then be installed on the simulator platform to compare the system's reactions under flight conditions and under actual flight.

This will give a greater test of the fidelity of simulation achieved.

Testing Program

Bell will use both the present cockpit and the HIL-7 cockpit for the testing program. The HIL-7 cockpit is more sophisticated since it provides the standard set of helicopter instruments and controls, and the test subject can simulate such things as engine start.

The testing program is starting out with very simple flight equations, although the computer and system are



Fairey Ultra Light Helicopter Goes to Sea

Typical helicopter developed by Fairey Aviation Co., Ltd., of England, is carried on platform of stern of HMS Gervaise to the English Channel during evaluation tests of the aircraft's ability to operate at sea. Helicopter is powered by a Blackburn Turboshaft Palomares turbo-gas turbine which supplies compressed air to passenger seats at rates 100 (AW April 8, p. 54).



ROYAL NAVY

The Mk. A-Bellini, first in class in the world, is now in service with the Royal Navy.



U. S. NAVY

The Mk. A-Bellini, first in class in the world, is now in service with the Royal Navy. The Mk. A-Bellini, first in class in the world, is now in service with the Royal Navy.

Martin-Baker

Aircraft Company Limited—England & Canada

handle such complicated equations as those for the 10 to 12 turbine helicopter thrust tests will use fixed wing experience and involve only level flight. The Bell tests must be conducted on display grounds and eliminate helicopter control problems for the test crew.

Subject Source

Subjects for the testing program will be drawn from Bell's factory population, although students as local test crew will be used later.

All subjects will be male and should be at least about 170 lb. as possible. Testers will use subjects who have never flown on turbine, and as many as possible will be persons who have never ridden in one.

Bell's marketing work is part of its long range quest for an ideal helicopter cockpit under the Army Navy program. Bell program, called Army Navy helicopter engineering project, started two years ago, about a year and a half after Douglas launched its fixed wing program.

Bell's program is based on the fact that the aircraft, and especially the Army, need a helicopter that can fly at low altitudes in bad weather without ground aids. And the instrument system should be so simple that the average helicopter pilot can fly it without extensive special training.

Since most helicopter instrumentation is actually fixed wing aircraft equipment and not very efficient for helicopter operations, Bell is starting from scratch to design and develop instrumentation specifically for helicopters.

Human Engineering Program

Such a project starts with the pilot who must use the instruments, and Bell has launched a substantial human engineering program to determine what information a pilot really needs to operate a helicopter. Courtney and Associates has completed a study for Bell on pilot information requirements for each mode of flight.

Bell will take this information and determine which flight data are most important, what instruments are necessary for various flight modes, etc. The next step will be to select an instrument that pilot requires to control various types of data display. While this preliminary work is going on, Bell is integrating cockpit hardware needs.

Development of an airborne computer has been ordered, and feasibility studies have been subcontracted for such basic instruments as altimeters, airspeed indicators and electronic systems. Work is also being done on high resolution radar.

OFF THE LINE

Wyle Laboratories, El Segundo, Calif., is constructing a high-flow liquid and gas turbine engine facility for testing aircraft engines and systems, as well as for checking and pre-testing engines ready for operational use. Technical assistance for the project will be provided by Lunde Co., a division of Union Carbide Corp.

Perkins-Dunn Corp. registered annual sales of \$12,713,565 for the fiscal year ending Feb. 28, 1957, ahead of last year. Net income was \$508,845, equivalent to \$1.15 a share compared to \$1.19 a share last year. Company's backlog of orders at the end of the fiscal year was \$1,469,000 and working capital reached \$1,156,774.

Perkins-Dunn's expenditures for research and development for the current year were \$746,741, almost double the \$481,507 spent the previous year. Company is expanding its headquarters at Newark, Conn., and is establishing subsidiaries in Canada and England.

New aircraft engine services agent **Aviation Engines, Inc.**, has been established at 510 Rockaway Turnpike, Lawrence, N. Y. Company services engines in removal from aircraft, strips them of cooling and accessories and subassemblies involved. Accessories are excluded by Avengines and cooling and short metal are repaired as necessary. When engines return after overhaul, Avengines installs them up and returns them to the aircraft owner. Avengines, which is a division of Aviamatic, Inc., can be reached or spoken from each service at Irving and Seaside.

Norfolk Airlines recently moved its Fiesels bound four-engine flights from Gate 11 to the Marine Terminal at Long Beach Airport. Four engine flights moved to the Marine Terminal two months ago. Two and four engine flights to New England will continue to use Gate 11.

Vickers Viscount propellers, four propellers to operate conventional, have passed the three-million propeller hour mark.



Folding Tire Developed

New type of aircraft landing gear, based on use of a folding tire, is being developed under a research program by Fairchild Aircraft Division. Program has entered the ground, or prototype phase. New tire and gear system is expected to solve many operating problems of short takeoff and landing (STOL) aircraft on unpaved fields. Short-takeoff (STOL) right fully inflated tire, partial deflation, and folded tire overcomes the cost of fully inflated cost. Features of the tire include continuous, high tensile nylon cord wound around the tire body (main carcass) to provide reinforcement at points where highest stress is expected, and a sensitive tire system for deflating and folding the tire so that it can be stored in space of a standard fuselage. Added advantage of the valve is that it allows the tire to be a high pressure and low pressure on ground surface and a low pressure when plane takes its flight. Folding tire does away with huge air problem of conventional low pressure tires.

PERFORMANCE PROVES CAPABILITY

INERTIAL GUIDANCE



Kearfott has been engaged in the development, production and flight testing of Inertial Systems and their components for over 7 years. Their leadership in the field of lightweight, high precision Inertial Guidance Systems for aircraft and missiles has been proved by performance. The equipment shown here is a typical KEARFOTT Inertial platform.

CENTRAL GYRO REFERENCE SYSTEMS



Based on the 3 gyro, 3 gimbal stable platform weighing only 35 pounds, precise vertical reference is guaranteed. This system also serves as an all attitude compass system with 1° per hour motion drift rate. Its performance is substantiated by the hundreds of systems in operation today.

LIGHTWEIGHT ALL ATTITUDE COMPASS AND VERTICAL REFERENCE SYSTEMS



Based on a 20-5 pound 3 gyro, 4 gimbal platform, Kearfott All Attitude Compass Systems provide continuous heading signals throughout a 140° hemisphere. In addition to the compass function of the U.S.A.F. 16 System, precise vertical reference for line control, autopilot and rocket stabilization is available. Proved by 2 years' service in the field. Total system weight—37 pounds.

GREAT CIRCLE NAVIGATION COMPUTERS



Kearfott's great circle dual redundancy computer systems, continuously compute and display present position, course and distance to a selected point and 3 alternate destinations, latitude and longitude of the destination point. Ground track is also indicated. Range 3000 miles, speed range 3000 knots. Extensive flight tests have confirmed the following accuracies: Present position—1 mile or 1% of distance traveled; Distance—1 mile or 1%; Course—1°.

COMPONENTS

Only the dependable accuracy of KEARFOTT Components have made the dependably accurate KEARFOTT Systems possible. KEARFOTT Components include Gyroscopes, laser drivers, Telemeters and computer circuitry. Their capability has been proved by years of satisfactory service in the field, subjected to radar and navigation systems. Write today for descriptive technical data.



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FLUISING UNIT CRANE weighing 1,000 lb. (above) is loaded into Dornier LZ-5 at an oil field supply point for flight to a well head. LZ-5 arrives (right) at a drilling rig located in deep back country. An engine is loaded into the helicopter (below) at the oil field. LZ-5 made over 10 down station flights in Louisiana, Texas, Oklahoma.



Dornier LZ-5 Gets Oil Field Check-Out



AT OIL DRILLING RIG in Cushing, Okla., Dornier LZ-5 methodically unloads parts. In course of about a month's demonstration to Southern oil producing area, the helicopter carried 231 passengers in addition to cargo. LZ-5's fuel consumption averaged 14.1 gph.



Waldorf announces an important new design concept... MICROMATION

MICROMATION—affers the system engineer complete package control sub-systems using little more than individual components... reduces time of control sub-system design and component procurement.

MICROMATION—provides maximum operational performance with size and weight reductions up to 60 per cent... designed to meet military specifications.

MICROMATION now makes available—

Model W1501—Transistorized Servo Repeater System; size 2" dia. 4" long, weight 11 oz. including amplifier, power supply, synchro motor and gear head.
Model W1503—Transistorized Servo Amplifier; size 1 1/2" dia. 4" long, weight 3 oz.
Model W1504—Transistorized Servo Amplifier; size 1 1/2" x 1 1/2" x 1 1/2".

In the heart of the W1501 Servo Repeater System illustrated are all the electronic and electromechanical components to develop shift position output with torque exceeding 30 oz-in. Status recovery is within 0.1 sec. of input from synchro or transducer. Velocity reaction is 60 sec.⁻¹. Response only 115V, 600 cps supply. Other configurations are available to suit your requirements. Uses include control of positioning devices, valves or computer elements.

May also be used as direct indicators. Meets military specifications.

Model W1503 Amplifier as used in the W1501 Servo Repeater is designed for maximum mounting surface—3 1/2" x 1 1/2" Dia.

Model W1504 Amplifier is identical electrically but packaged for maximum volume—1 1/2" x 1 1/2" x 1 1/2". Both accept synchro, potentiometer, or other transducer data. Both drive size 5 or size 16 motors.

Interested? If these product improvements—or the rising requirements in MICROMATION—navigation, differentiation, coordinate-conversion, vector solvers and power supplies challenge your imagination, we just ask for further data!

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INSTRUMENT COMPANY
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enabled replacing the former 20,000-lb. unit, new boring light has been increased to 250 with 100 extra and carbide tool has been capped. In the latter change, Piper engineers say they got a fast 200-dig. run in the carbide or less with practically no drop in material prices.

Prices for the 1978 Apache start at \$35,990 for the Standard model with 160-hp. engine. Custom version will be \$38,945 and Super Custom will be \$40,735. For comparison the 1978 Apache with 150-hp. Lycoming will cost \$34,990 for the Standard model, \$37,045 for the Custom and \$38,735 for the Super Custom.

Aside from engine ordering and the 190-hp. engine, the new Tri-Pacer is basically similar to previous models. Prices for the 1978 models Standard, \$4,595, Custom, \$6,770 and Super Custom, \$10,475. With the 198-hp. Lycoming, respective prices are \$5,565, \$7,870 and \$10,175.

New Design

Knowing their growing popularity, more distributors and dealer networks and more attended the 1978 sales meeting than any previous year, requiring a shift from the company's home town of Los Angeles to nearby Wilmington.

These were approximately to distributors whose sales in the fiscal year ending September 30th were in the \$1 million bracket, one whose sales exceeded \$2 million by a wide margin, one who almost reached \$1 million and another who came close to \$4 million.

For them, Piper sales manager J. W. (Hole) Miller set a goal for the 1978 fiscal year of \$79,250,000 in commercial sales or 1st place. The company to \$55.7 million they achieved in fiscal 1977. And he told them that he expects them to achieve sales of \$60 million at list prices in 1978.

Indicating that Piper's success in sales volume in fiscal 1978 will come as much from increased prices as from a jump in number of units. Noting all of sales but very little the low cost aircraft industry's record success in 1976 will probably continue into 1978, and then show another rather able rise, Miller said business was.

One of the major obstacles facing the industry has been on cash flow to make necessary gains in cracking the market. Piper dealers were told to buy the sales picture has been outside one of "handcuffing," with only about 25% of sales going to first five years.

Forecasting Aid

While one of forecasting would also brighten the picture, Miller noted the pointed out that the top Piper dealers



APACHE panel is specially designed to take a large variety of instrument light equipment.



NEW TRI-PACER, with 160-hp. high-compression Lycoming has 710 cfm. prop.

1978 Piper Tri-Pacer

DESCRIPTION	PERFORMANCE
Engine: 160-hp. Lycoming O-360-A 1 1/2" x 1 1/2" x 1 1/2"	Full capacity (2000 ft.) 140 mph
Empty weight (Std.) 1,100	Turned (up) at 7,000 ft. 140
Gross weight (Std.) 2,000	Cruise speed at 7,000 ft. 134
Useful load (Std.) 900	Rate of climb (Std.) 600
Wing span (Std.) 35.0	Service ceiling (Std.) 16,000
Wing area (Std.) 147.0	Absolute ceiling (Std.) 18,000
Wing chord (Std.) 30.0	Power-to-weight ratio (Std.) 11.0
Length (Std.) 28.0	
Height (Std.) 6.0	
Propeller diameter (Std.) 4.0	
Power loading (Std.) 12.0	
Wing loading (Std.) 13.0	
Engine capacity (Std.) 170	



Left: Zenith 100A. Right: Piper Apache light plane.

Bring your tough ones to Zenith

Take a minute with a man at it, the Lockheed F-104A opens the sky at speeds of over 1200 mph—and Zenith rides with it, right on the case!

Is built the engine on this remarkable aircraft demanded unprecedented techniques in the construction of a semi-bonded glass fiber form. Besides its vital rubber features, the redone unit is an integral part of the aerodynamic design. To effect this unit is the nose cone of a tapered pyrex the with the velocity of a 10-inch shell. It must withstand the shock of the sound barrier. It must endure the swirling heat of atmospheric friction. And it must maintain its elastic sensitivity unaltered!

To meet these extreme requirements, Zenith would hand and long with Lockheed engineers. The result was a new

plastic material—a material that gives the maximum stability while electrical performance at elevated temperatures while retaining its full rigidity and strength.

This was the sort of tough assignment that waits on your appetite at Zenith. Our continued success in coping with challenges like this has taught us how to form semi-bonded glass fiber for almost every electronic and structural purpose, in almost every shape and size. And we can apply modern, production line methods to the job, and often slash costs and tooling time in the bargain.

Zenith's reinforced plastics are the only answer for some structural components—and a better answer for many. We invite you to "bring your tough ones to Zenith."

Zenith Plastics Company

1600 West 135th Street, Gardena, California
 Subsidiary of Minnesota Mining and Manufacturing Company



FORM OF THE FUTURE: RESIN-BONDED GLASS FIBER



Sabre Clips Apache

Piper Apache light to an business plane made a safe landing at Elgin Airport, Ill., after the top of its tail was clipped off by a two-plane element of F-104. Sabre jet fighters making a safe approach into O'Hare Field, Chicago, at about 7 p.m. CST, recently. Accident occurred in vicinity of Bensenville at about 2,000 ft. under low-level VFR conditions, while Apache pilot Chad Brown was en route to Elgin. According to Brown, subsequent investigation revealed that none of the pilots involved saw each other, that Air Force had the F-104 on its radar, but not the Apache.

Two last year probably featured 80% of their sales. Those not exceeding their quotas available used financing on only 10% 15% of their business. Last figures he had available showed that in 1970 about 52% of the aircraft sold were financed via financing.

Importance of dealer selling used Piper airplanes today on trade-in on new airplane sales instead of disposing of them to outlets specializing in used aircraft also was emphasized by Miller. He pointed out that over 115 used Apaches or 25 51 used Tri Pacer in "outside" channels can noticeably deplete pools of newer models.

Suggested was a method of rebidding used Piper aircraft held by dealers and a system of rescheduling the lot among the sales organization to find the aircraft could be placed where they might be needed, thus lowering the chances of large numbers of planes going out on the open market.

Export sales are showing trade increase in fiscal 1971, Piper noted 23 1/2% of its total overseas compared to 14 1/2% in the previous year. In fiscal 1971, 87% of all PA-12s and PA-13s were shipped in the about 17% of the total Apache output and about 10% of Tri Pacer production.

Delivered to New Zealand, for example, accounted for two Piper ac-

planes in 1971 to 1970 to 32 in 1971. Many of export restrictions in that country and Australia make those important future markets according to distribution in that area. The Apache line definitely will increase. Work that although there are now only 70 Pipers at all makes there now, he has export losses to long in 40 since the year and will bring in a Corcoran at once as he can get one.

Addison Airport Makes Lease Arrangement

Long-term leasing arrangement of more than \$250,000 covering more 160 ft x 160 ft hangar has been arranged between Addison Airport, North Dallas, Tex., and United States Leasing Corp's Dallas office.

Recently, U. S. Leasing purchases the



British Test 'Luxury' Light Plane

Designed specifically for executive operation, new Antler Atlantic four-seater is designed to compete with Piper Tri-Pacer and Cessna 172 202 series business planes. Antler reports he has not yet flown the conventional type version, only a subcompact prototype. Powered with a Continental 2115-40 engine rated at 205 hp, wheel and 105 hp. current, the Atlantic is designed to cruise at approximately 185 mph and have a range of 600 mi. Planned is a maximum payload of 715 lb. An approximately one-hour cruise (normal payload) for 400 mi. still on depending on load, and rate of climb would vary from 300-1,100 ft. Although the airplane has not yet reached the production line, Antler estimates that fully equipped it will cost approximately \$15,000. Among equipment shown in Antler-built Nova radio. Upper right on panel.



AVIATION WEEK, November 4, 1971



CARRYING load with load of structural steel for power line tower it adjusted an S-58 for shift to maintain edge air

S-58 Expedites Power Line Installation

By Richard Sweeney

Vestas, Calif.—True use of heli-copters to install high voltage electrical power transmission lines proved so successful that Southern California Edison Co. is planning to use many more aircraft extensively in future power line installations.

Edison reached from recent experience in which Rotor-Aids, Ventura helicopter firm, was called in relatively late in construction job in progress to use lift structural steel for towers of new 115-kv line. Operation was possible a study of conditions in which Edison learned an S-58 from Sikorsky, which Rotor-Aids acquired along with its own Bell equipment as the study progressed.

In transmission line planning, level rights of way are a major cost factor in fact, up to now, line paths and tower sites have been largely dictated by accessibility of sites via roads over which men, materials and equipment could be trucked for construction. Another high cost is road maintenance via in and out only, so long as the line exists.

Ligation Time Cut

Another aspect of rights of way and out-of-pocketings involved when a company has to erect its construction line proceedings to acquire the right to install lines. One of the helicopter firm enables a company to site work from areas where procedures would normally meet less expeditious, thus eliminating loss of time in litigation legal costs beyond it enables a company to generally install a new complete line without part of it held up in law proceedings.

Rotor-Aids and the performance of the helicopter led Edison to plan the



AVERAGE line of sight distance from loading depot to tower site was 3.5 mi.

S-58 DROPS load of steel (below) at tower site. Two pilots sharing tasks improved efficiency



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New positions in:

MISSILE SYSTEMS AERODYNAMICS

Weapon system management activities at Lockheed's Palo Alto, Sunnyvale and Van Nuys organizations will be major subelements in aerodynamic new work in: Theoretical and experimental investigations of the aerodynamic characteristics of missiles at Mach numbers through the hypersonic range; optimization of controlled missile performance; specification and supervision of experimental aerodynamic investigations required to verify and improve missile and weapon system design; analysis and interpretation of aerodynamic flight test data. Inquiries are invited. Please address the Research and Development Staff, Palo Alto 17, California.

Many members of the Aerodynamic Research Staff during of jet transport vehicles. Left to right: W. E. Brund, aerodynamic analysis; M. Tuck, aerodynamic analysis; Department head, R. E. Nelson, project aerodynamic; R. W. Marsh, aerodynamic; J. T. Osborn (back to camera), aerodynamic.

Lockheed MISSILE SYSTEMS

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

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Executive Convoir Gets Light Stairway

Removable stairway, near 200 lb. lighter than standard Convoir-Lever installation, was fitted to the convair CV-340 within two weeks of customer's order by Pacific Aircraft Corp. (Pac), a former Subcon Region Airlines' transport, is one of the approximately 40 Convair manufactured with a self-contained stairway. Pacific Aircraft located its stairway of the plane's rear door, made possible by opening it from the cabin as from the ground. Major problems involved space limitations, proper placement of support wires and motion cylinders in open and close the door. Involving precise measurements for various stages of extension cycle. Modified CV-340 belongs to Monro Corporation of America, Detroit, Mich.

following sequence for construction of the next impression line.

• Edges will be able to go into area where lights of way will cut loss will not need access roads, and bars can be set along better routes through rough road.

• Service for lights of way will be accomplished with Bell helicopters.

• Small crew will be flown in to clear way area where maximum brightness weighing less than 1,500 lb. can be "captured" in, used to clear 15,000 lb. heavy sets.

• Portable anger will be carried in to drill during long. Bunking steel bar bearings, already fabricated and precast shape, will be drilled by helicopter to site.

• Heavy mix concrete, weighing approximately a ton per cubic yard, will be drilled to burlap, back into squares from footings, with 4 cu. yd. per footing.

• Tower steel will be flown in, loaded by 1,500 lb. per load.

• Tower will be erected with floating gas pole, which weighs less than 3,500 lb., will be moved by helicopter from site to site.

• Low stringing will be accomplished by helicopter and ground crew.

In transmission, low, conductive cable is not completely fixed at each tower, rather is attached at certain even strong points called dead end towers, which are bound with varying number of supporting towers in between second

ing to towers. When a section is to be strong, system is in a tensioning machine to the dead end tower at each end of section to be erected.

Staging Operation

Using with, a Bell helicopter will place 4 in. inside rope from one dead end tower to another, with lifting as necessary for rope constantly accumulated by ground crew, while "cable" layers. Ground crew will then use tension machines to pull 4 in. inside cable across the span in place of rope. Aircraft cable will pull 4 in. rope into place, which will be then be used to haul the very heavy conductive into position where it is located to dead end tower and attached as necessary to intermediate supporting tower.

Tension machines, crews, will then be moved to next section that is to be strong.

In feasibility program, several factors worked against the helicopter. The steel was already loaded for loading in packages weighing from 1,700 to 3,500 lb. A 50% increase in efficiency could have been gained if the steel was handled to 500's maximum 1,500 lb. per flight capacity. Also, to take advantage of wind effects along already existing line, Edna is constructing a new line close to the existing high voltage line, increasing the load to a helicopter carrying loads of steel. Another hazard was flying into into hospital post below mountain tops where

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ANODIZED STEEL
with nylon seating ring
for aircraft A-104

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Steel nut and
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ANODIZED STEEL
with nylon seating ring
for aircraft A-104

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washer, steel nut

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machines and rough air currents were encountered.

Despite two-on-one action, helicopter ranked up some favorable statistics during the operation.

In actual program, 1,161,375 lb were airlifted in 61 hr, 13 min flight time, including three time losses from operating loss at Vietnam to the three times used in loading depots. Loading rates were picked so that the average rate of eight thousand tons per trip was 10 min from depot to target site.

Best operating rate was 136,070 lb carried in 8 hr 18 min flying time. Fluctuations occurred in daily weight totals due to variation in loads. While steel was primary cargo, supplies also lifted included, baskets of auto parts and various material but necessary items for construction. Rockets, stings and other equipment used in the lift had to be returned from target site to loading depot.

Finished Quickly

Rotor Aids quickly planned the operation to begin upward of four weeks. However, job was finished in 15 flying days between Sept. 30 and Oct. 18. On the basis of 15 calendar days in which 51 hr 10 min were flown to haul 936,799 lb, direct operating cost was \$11,450 excluding depreciation and insurance.

At the loading depot, one pilot again stood as head agent to cargo pilot supervised steel load progress to get 1500-pound overloading kept within, get results.

Other aspects brought out in operation were: Navy's, both carrier pilots, both active helicopter and fixed wing pilots. Both took an active part in 8-55 flying on the Edison job.

Coastguard has been operating its own 11 Bell 47s, two F4s, two F6Cs, seven Model 47s, and Hawk 47s. Go's own 5-55, then 8-55, is the Gulf of Mexico air operation (AW Dec. 31, 1956, p. 17) and two 8-55s in Alaska. All 74 operating pilots are returned to the Gulf, to California, to Alaska.

Pilots Experienced

All had more than 750 hr heli-copter time when hired. Coastguard also employs 15 mechanics in doing all its own maintenance except engines on the Bells. On Sikorskis in the Gulf they do some major component work and overhaul work in the States. But in parallel living conditions in the Gulf operation, Rotor Aids has had to compromise its desire to do all its own maintenance in real dollars in shipping men, scheduled at home in the end, with the cost. However, in Vietnam, all maintenance except engines is done, but complete overhaul is capable of doing this too if required.

Coastguard employs 78 persons, has never had a kill due to lack of business.

- ▲ Excellent life and reliability
- ▲ Higher overall efficiency than conventional alternators (no excitation losses)
- ▲ Smaller, lighter than conventional alternators (brackets, slip rings, bulky voltage regulator eliminated)
- ▲ Built to customer specification

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MAGNET ALTERNATORS**

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NOTARY INVERTERS

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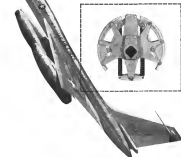
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manhandling the "Hustler" demands instant control response



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With today's increasing speeds, faster changing ability and higher altitudes, the problems of maintaining accurately coordinated control are magnified.

Aerodynamic and turbine temperatures vary widely and fluctuate rapidly; performance depends. That's why automatic compensation of control cables is increasingly important in advanced performance aircraft such as Convair's new F-106 fighter.

All the proposed cable control systems on the F-106 are Pacific Regulator because their simple mechanical design continuously compensates for both dynamic and mechanical variations in the system—to keep control cable in constant tension regardless of all factors—under all flight conditions!

In a dynamic, Pacific Regulator allows a significant reduction of the rigid torsion of the system because cable tension stays rigid. This means a reduction in drag and less wear in the system, and the result is a very considerable weight savings.

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PRIVATE LINES

Crews will start deliveries of new Model 177 four-place in March priced at about \$11,600. Powered by a 175-hp Continental plane is designed to fill market gap between Model 172 and Model 180, Cessna states.

More than half the loans reported from Small Business Administration by food store operators for facilities expansion have been granted according to a report from the Small Business Administration to the Civil Aeronautics Administration. As of July 31, 1967, some 61 applications regarding \$2,729,467 were received. Of these seven were later withdrawn, 27 applications regarding \$3,212,285 were approved and 24 involving \$1,373,236 were turned down. Three applications totaling \$11,160 were pending. Almost half of the total funds applied were for seven larger projects totaling \$185,830. Most of the other loans went to get off loans and bank loans.

U.S. Air Force is seeking about 1,500 aircraft for sale through July 4, 1968. Included will be 256 North American B-70, 104 B-70, C-119 (Model 151), 162 North American T-28A, 615 Douglas B-26, 84 North American F-100, 108 North American F-101, 116 C-119, C-119A and B, and 18 B-70, 170 (Naval). Sales will be made at McClellan AFB, Sacramento and Nether AFB, San Bernardino. Interested parties can contact the Property Disposal Office at these bases.

Manufacturing rights to complete helicopter started by Michigan Helicopter Development Corp. have been assigned to Martin Aircraft Corp., a newly formed division of Melroe Tool Co. St. Clair Shores, Mich. First prototype of the helicopter is scheduled for test in January. Buyer is four weeks contract ending in May.

Some 500 pilots have completed in four new ground school with students currently being held by the Department of Aeronautics. Offered of no charge, courses cover 11 hr classroom instruction in navigation, aerodynamics, civil air regulations and general safety procedures. Then for 3,500 pilots have also 59,675 hr of instruction in the department's safety course.

The Garrett Corp.'s A-100000 Mfg. Co., Los Angeles, is manufacturing a new production equipment for the Cessna Model 440 executive transport being built by the Cessna Aircraft Co., Van Nuys, Calif. System similar to that designed for the Beechcraft 707 and Cessna 440 jet aircraft.

MAA IS AT WORK IN THE FIELDS OF THE FUTURE



NEW HORIZONS ARE AHEAD FOR MANNED AIRCRAFT

No matter how far man's technical ability may soar, he himself has one faculty no machine will ever duplicate—the ability to make a command decision.

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America's strategic missiles will be mighty instruments to our nation's defense. But for maximum security, America also needs a new kind of manned weapon system—an advanced in performance as that now being developed in Europe.

These new airplanes must fly so fast they can strike with little or no warning...so fast they can avoid any target on earth...so high they can search a space-to-earth missile.

Such aircraft are now being developed at North American Aviation. Extensive studies, in collaboration with the Air Force, have already resulted in a unique design concept for Weapon System 11A, an incredibly fast supersonic manned bomber, with global range. Other field concepts now being developed by North American include a long-range interceptor and the X-59, a rocket-powered research plane that will carry three men into outer space.

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AVIATION WEEK

Classified Advertising Division

AVIATION WEEK November 4, 1957



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For further information on your career opportunities at Goodyear Aircraft, write: Mr. C. G. Jean, Personnel Dept., Goodyear Aircraft Corporation, Akron 15, Ohio.

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Speech and Security

Regarding the case of Capt. Specht (AVF March 15, p. 50), I would like to offer some observations from the passenger's point of view. During the past year, I have worked as an engineer on an air force mobile project. This involved riding three or four times a day to the East Coast rock 'n' roll, riding around major construction sites, and being constantly with the military security police.

There is a strong analogy between a commercial pilot's home and a man's or woman's home. As he or she is concerned the plane should be as "homelike" as one can find. Our lives are in his hands.

In such circumstances, the security program we have had to digest from our point of view concerning security and a person. Particularly all the rules of which we are surprised because we're concerned and unexpected but all pilots have studied and become, in part, we're parents, but only because all pilots could not be absolutely removed. We prefer to assume that individuals are reasonable, but if not willing to let that they are with us.

After reading the first article in which you published, I would never fly with Capt. Specht unless he could prove that he acted as a real emergency. Capt. Specht may be a completely competent pilot of the state, as was some engineers as my defense crew. The passenger has to think first of what happened when he takes off his seat.

It would certainly be more reasonable if the ALFA showed a trace of interest or understanding of the passenger viewpoint.

WILLIAM ARON
Casper, Pa., Calif.

Cockpit Complications

Capt. E. C. Johnson (AVF Sept. 5, p. 51) couldn't be more right in regard to the "new rule" ALFA (Automatic Landing) finding no solution and how difficult it is to see them under operational conditions.

I am flying with him represented every day and believe the objectives presented this is really good.

On closed terrain problems it is a good idea to have a "new rule" which is not for "handoffs" one for "time" and one for "time." It is then necessary to not fly or for some moments pilot designated from the other side of the cockpit.

The pilot control panel are widely separated from each other and below the horizon window. They seem to have little relation with the number controlled and when you can't obtain the machine confusion doesn't lead it as a difficult as opening a door in the steps, makes it easier. I'm missing the look, there makes the numbers more to get the opposite direction at that point.

As a hypothesis is changed, to move the feet from one knob to the other occurs an actual downward phase each time to make sure you have what you need for,

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which becomes quite a project in a dash cockpit. The entire display set my entire has actually pointed a whole lot from the back to the forward instrument dash area. It should have been focused.

Facing the volume control knob, which is quite inside in fact to the other than and directly below the center one, seems like quite a search in time elements when the other meaning is to be set of signal strength goes up or down, but more than that not knowing the system of frequency which necessitates releasing before changing of the search. Developmental finger are quite helpful.

Keeping the receiver in use required handling of an frequency control knob and a volume control knob in a need of sight. This results in a "look" in the cockpit window, much longer than was thought. Confusion much longer than was thought to be necessary in their days of no instrument operation.

I have heard nothing but the hottest of complaints from those faced to use this concept. Can't see plane here and coffee grinder back, Mr. Yeager?

ARMANDO PERRY
Berkeley, N. Y.

Likes Editorials

I am only an ex-GI and former AMV mechanic, but I put vented to write to you and let you know that I understand the low level demands in Aviation Week. You are more serious critical, but in my book you are right and a credit to your profession. What this magazine means to me is that you will tell the public for facts on matters they go to but it is a pleasure as a civilian fan.

I thank Aviation Week as a well kept one for its serious content and information. I will be looking for you in next week's issue. I am a fan. (Aviation Week) Editor.

Nashville, TN.

Private Flying

With reference to an article in your Oct. 14 issue of Aviation Week (p. 115) on titled "Expensive Business Flying: Growth Seen," by Edwin J. Ballou, I asked the following question: What are some of the factors that put it as it is some to inform that means these days taken the time to go out and get the point of view from the pilot's point of view.

In the other matter, I say that there are only two ways that the word "person" flying was mentioned. The single is seemed to be placed on the island at the side, and the business and the business with activities. None of it there are no

plotted, and more of these should be included. Certainly, more should be included in the article on the subject. For example, if this happened on an highway and steam, gradually, every individual would probably protest that the use of his power—indeed, very being separated out at evidence in the back of the back and down. The private owner of the aircraft as in the matter, does not have the power to go to protect themselves. They are probably being forced to give up the same at transportation which could be the largest segment of the entire air traffic industry.

Unfortunately, on some of transporters it is very better than the safety that is included. To make points being pointed for the safety man, these things must be made a point.

• Hydraulic system of landing strips across the runway.

• These landing strips should be elevated the same as an airport and highway, even if that they are not, would have the use to help the usage pilot with his usage.

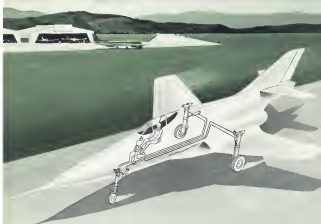
• These landing strips laid out on a system like that to show him to cope with adverse weather conditions that man, people keep him in time.

This plan is not new. It was studied and assembled during World War II through the efforts of some of our outstanding aircraft men. The plan is so simple and would cost so little compared with the investment of our economy and among a standard of our people. But it seems unbelievable that the people of a great nation such as ours should not take effective action to put the plan into effect. Maybe the reason that it was never put into effect was that it seemed to be too simple and aggressive and would be looked by government agencies which already exist and in addition to this, it certainly would require law, construction, maintenance, which is the real American way. Maybe we all have to keep them in the state of confusion.

I note that Mr. J. B. Gresham, speaker at the President's Conference and other men of the Army's Management Board in April of 1950, to say, on aviation, at the time, it certainly has, for the good of the industry and the country that it is to be taken the present. (Aviation Week) The aircraft industry has a "new rule" pilot and "handbook" landing system. We all should understand that the automobile business can act such as we're. The automobile did not, however, we created rules in specific times. The same applies to the private airplane.

I agree because that we've better go back to some old-fashioned, simple thinking and reverse the transition in thinking which is really destroyed at the moment. Our minds are running from progress to go to continue to use ourselves and to get into a state of a faster pace that something is going to have to bring us back down to earth.

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Hughes Falcon... missile with a "brain" finds and hits enemy bombers

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